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THE ROYAL ENGINEERS JOURNAL.

Vol. XXIV. No. 1. JULY, 1916.

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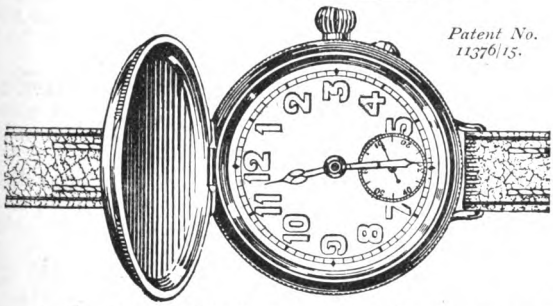

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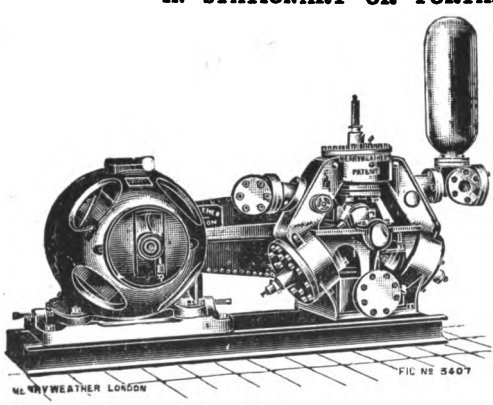

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TEMPORARY GIRDER BRIDGES

By MAJOR O. G. BRANDON.

(The writer requests us to acknowledge the assistance he has received from the articles previously contributed by various officers on the above subject to the *R.E. Journal*, etc.).

As amongst the large number of officers now serving there may be some who have had little experience in dealing with such problems the following tables have been prepared as a guide to anyone who may be called upon to undertake bridge repairs, as also with a view to obviating the necessity of calculation on the spot. A type of girder has been selected which can be quickly and easily made from any material that is available.

Table A shows the sizes of members of girders of all principal spans from 10 ft. to 100 ft.: the requirements for any spans not included in the table can easily be arrived at by inspection.

The bridge in every case is designed for a *single* roadway to carry the heaviest motor lorries and can be built any width desired up to about 13 ft. in the clear. The girders and wheel guides should be arranged so that the load may be borne as far as possible directly on the girders; this will be so if the position of the girders is arranged between the limits shown on plan.

It is recognized that for simplicity of working the same size of material would often be employed throughout, but cases may arise where shortage of time or material might make it desirable to use only what is essential; hence in all cases, the maximum and minimum *sectional areas* of members has been shown, to allow of any size of material being used; in addition, columns have been added showing certain sizes of material which would usually be available, and the quantity required.

Table B gives a rough rule for hasty bridging to carry 3-ton lorries.

Table C gives a formula from which any member of an "N" type girder of any span can be worked out. This formula has been arrived at by analogy from a consideration of results given by the "method of sections."

Table D shows the method of calculation employed applicable to any case, as well as an example worked out for a particular span.

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Table D shows the method of calculation employed applicable to any case, as well as an example worked out for a particular span.

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TABLE A.—GIRDER BRIDGES TO CARRY SINGLE ROADWAY FOR HEAVY MOTOR LORRIES.

I.e. up to 17,700 *lbs. on back axle and* 7,100 *lbs. on front axle and crowded* (10 *ft. between back axle of one lorry and front axle of next lorry*).

Span. Feet.	No. of Girders.	Bays.			Booms.			Verticals.			Diagonals.				Bolts for Boom Joints.		Alternative to Diagonals.			Remarks.
											Centre.		End.					Per Bay of each Boom.		
		Number.	Length. Feet.	Depth. Feet.	Maxm. Area. Square Inches.	No. of 9″ × 3″ in Centre.	No. of 9″ × 3″ at End.	Maxm. Area. Square Inches.	No. of 9″ × 3″ in Centre.	No. of 9″ × 3″ at End.	Area. Square Inches.	Diam. of Bar. Square Inches.	Area. Square Inches.	Diam. of Bar. Square Inches.	No. each Side of Joint.	Diameter. Inches.	*Web Planking each Side. Ins.	¾″ Bolts or 6″ Nails.		
10	2	4	2 6	2 6	8	13×3	13×3	15	13×3	23×3	·4	¾	·8	¾	4	¾	¾	7	70⁴″	The roadway may be carried on either top or bottom booms, but the former is preferable as it is easier to arrange the roadway. If necessary to have the latter arrangement, cross-bearers should be placed about 1 ft. apart and the roadway laid on top of these and parallel to the bridge: special care must be taken to ensure that the cross-bearers rest evenly on all the girders.
20	2	4	5	5	11	14×3	14×3	22	14×3	24×3	·6	⅞	1·2	1⅜	5	¾	½	15	100⁴″	
30	2	6	5	5	28	19×3	19×3	38	19×3	29×3	·9	1⅛	2·2	1¾	—	—	¾	17	180⁴″	
40	2	8	5	5	44	2	1	44	1	2	1	1¼	2·7	2	10	¾	1	15	88	
50	2	10	5	5	75	3	2	59	1	3	1·2	1⅜	4	2¼	11	¾	1¼	16	120	
60	4	10	6	6	44	2	1	32	1	2	·4	¾	2·3	1¾	10	¾	½	20	66	
80	4	12	6 8	6	75	3	1	40	1	2	·9	1⅛	3	2	9	1	¾	18	80	
100	6	14	7 2	7	68	3	1	40	1	2	·8	1	2·2	1¾	8	1	½	20	80	

* If web planking is used (instead of iron diagonals) of the thickness shown, the planks must touch each other at the abutments: in the centre third bays they may be spread their own width apart as "A" in sketch.

* If planking double the thickness shown is available this may be placed its own width apart at the abutments, and double its width apart in the centre third bays, as "B" in sketch.

If it is desired to make the verticals of iron and the diagonals of timber, the direction of the diagonals must be changed so as to slope UPWARDS towards the centre of the bridge: the sizes of material required in this case can be ascertained from the table as follows:—

$\frac{1}{10}$ × area of wood vertical in table = area of iron vertical (which is now in tension).

10 × area of iron diagonal in table = area of wood diagonal (which is now in compression).

N.B.—This method of conversion can *not* be applied to replace wood by iron unless the direction of the diagonal is changed.

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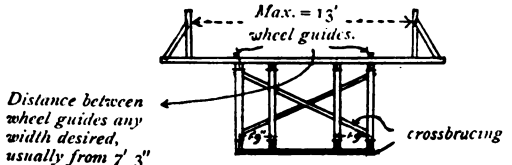
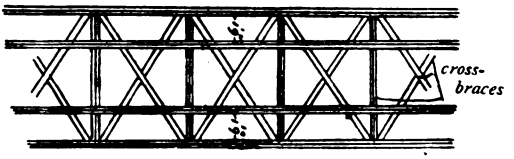
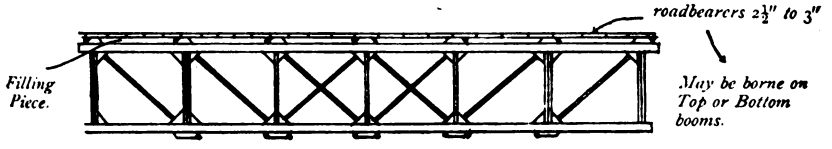


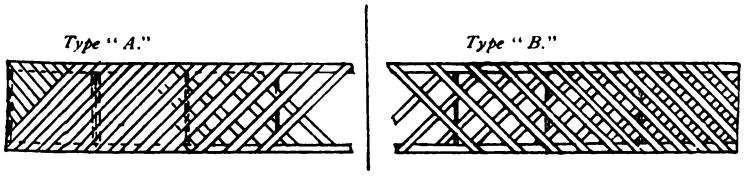
CROSS SECTION.



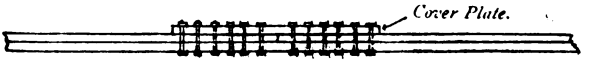
PLAN.



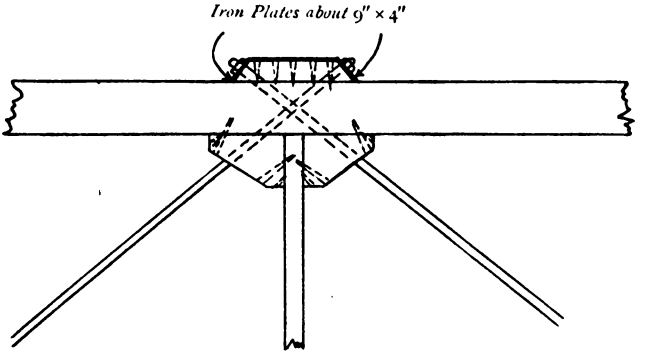
ELEVATION.



ELEVATIONS OF TWO TYPES OF SIX-BAY GIRDERS WITH PLANK WEB.



PLAN OF GIRDER SHOWING JOINT.



DETAIL OF BLOCKS FOR IRON TIES

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TABLE B.—ROUGH IMPROVISED BRIDGES TO CARRY SINGLE ROADWAY OF 3-TON LORRIES, CROWDED.

I.e., 10 *ft. between rear axle of one lorry and front axle of next lorry.*

Span. Feet.	No. of Pieces of 9″ × 3″.	Round Spars. 8″.	W.I. Girders. 9″ × 4″.
5	6	5	2
10	11	9	4
15	16	13	6
20	22	18	9

ROUGH RULE TO CARRY 3-TON LORRIES.

Number of 8-in. diam. spars or number of beams 9 in. × 3 in. = Number of feet span.

Brick or stone arches (with a good rise) up to 20-ft. span. Thickness of arch ring in inches = Number of feet span.

Brick or stone arches (with a good rise) 30 to 50-ft. span. Thickness of arch ring in inches = Half of feet span.

KING "TRUSSES" AS SKETCH.

Span.	No. of Girders.	Each Girder.		Each Girder.
		Boom Pieces 9″ × 3″.	King Beam 9″ × 3″.	Tie. Circ. 1¾″ or 2″.
10	2	2	1	6 or 4
15	2	3	1	6 or 4
20	2	4	1	6 or 4

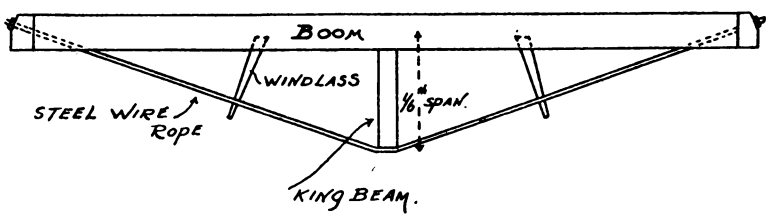

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Table C.—FORMULÆ FOR STRESS IN MEMBERS OF GIRDERS.

T = compression in top boom.
V = stress in verticals.
D = stress in diagonals.
w = maximum lorry load in lbs. at each panel point.
p = dead load in lbs. at each panel point.
n = number of bays.
d = depth of bay.
b = breadth of bay.
θ = angle between diagonal and boom.

Each type of member of girders is numbered 1, 2, 3, etc., from one abutment towards the centre.

R represents the number of any member.

$$T_R \times d = -(w+p)\, b \times \left\{\frac{R}{n}[1+2+\ldots(n-1)] - [(R-1)+(R-2)+\ldots+1]\right\}$$

$$V_R = (w+p)\,\frac{1}{n}\left\{1+2+\ldots+(n-R+1)\right\} - \frac{p}{n}\left\{(R-2)+(R-3)+\ldots+1\right\}$$

$$D_R = V_R + 1 \text{ cosec } \theta.$$

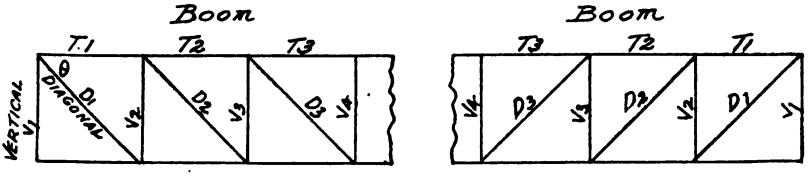

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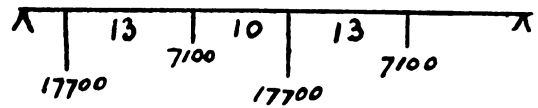
TABLE D.—METHOD OF CALCULATION.	 EXAMPLE WORKED OUT FOR 40 FT. GIRDER LOADED AS ABOVE.
Total live load = W	... ... $2 \times 17700 = 35400$ $2 \times 7100 = 14200$ 49600
Equivalent dead load = 2W	 99200
Allow "n" panels of depth "d" ft. and breadth "b" ft.	Allow 8 panels of depth 5 ft. and breadth 5 ft.
Dead load per panel $= \frac{1}{n} \times 2W = w$	... ... $\frac{1}{8} \times 99200 = 12400$ 800
Weight of panel $= p$ Total weight on each panel $= w + p$	 13200
Boom.—Let "r" be the number of any member in which it is required to find the stress.	To find the stress in top boom panel No. 4.
$T_r \times d = -(w+p)\, b \left\{ \frac{r}{n} [1 + 2 + \ldots\ldots + (n-1)] - [1 + 2 + \ldots\ldots + (r-1)] \right\}$	$T_4 \times 5 = -13200 \times 5 \{\frac{4}{8}[1 + 2 + \ldots + 7] - [3 + 2 + 1]\}$
$T_r = A$	$T_4 = -13200 \{\frac{1}{2} \times 28 - 6\} = 105600$ lbs.
Allow F. of S. = 5. Safe stress in fir = 1200 lbs. per sq. in.	
Area required $= \frac{A}{1200} - C$ sq. ins.	... ... $\frac{105600}{1200} = 88$ sq. ins.
Allow for Y girders.	Allow for two girders.
Area of boom for each girder $= \frac{C}{Y}$ sq. ins.	... ... $\frac{88}{2} = 44$ sq. ins.
I.e. B. pieces of 9 ins. × 3 ins.	*I.e.* 2 pieces of 9 ins. × 3 ins.

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METHOD OF CALCULATION—*cont.*	EXAMPLE WORKED OUT FOR 40 FT.—*cont.* GIRDER LOADED AS ABOVE—*cont.*
Bolts for Boom.—Stress on bolts $= A \times \frac{1}{Y} \times \frac{1}{B}$	... ... $105600 \times \frac{1}{2} \times \frac{1}{2}$
A "t" diam. bolt through 3-in. timber takes stress $= t \times 3 \times 1200 = t \times 3600$ ...	A $\frac{3}{4}$-in. bolt takes stress $= \frac{3}{4} \times 3 \times 1200$.
Number of bolts $= \frac{A}{Y \times B \times t \times 3600}$	... ... $\frac{105600}{2 \times 2 \times \frac{3}{4} \times 3600}$
Verticals.—Total load $= n \times (w + p)$	... ... 8×13200
R_1 at abutment of each girder $= \frac{n \times (w+p)}{2 \times Y} = K$	$\frac{8 \times 13200}{2 \times 2} = 26400$
Since "d" lies usually between $\frac{1}{12} \times L$ and $\frac{1}{24} \times L$ safe stress in fir $= 600$ lbs. per sq. in.	
Area of vertical at abutment $= \frac{K}{600}$ sq. ins.	... ... $\frac{26400}{600}$ 44 sq. ins.
I.e. S pieces 9 ins. × 3 ins.	*I.e.* 2 pieces 9 ins. × 3 ins.
Diagonals.—Load on panel of each girder $= \frac{w+p}{Y}$	... ... $\frac{13200}{2}$
Now $V_r = \frac{(w+p)}{n} \{1 + 2 + \ldots\ldots\ldots (n - r + 1)\} - \frac{p}{n} \{(r-2) + (r-1) + \ldots\ldots\ldots + 1\}$	$V_2 = \frac{13200}{8} \{1 + 2 + \ldots\ldots\ldots + 7\} - \frac{800}{8} \{0\} = 23100.$
Now $D_r = V_{r+1} \operatorname{cosec} \theta$.	$D_1 = V_2 \operatorname{cosec} 45^\circ = V_2 \sqrt{2} = 23100 \times 1{\cdot}41 = 32571.$
Since safe stress in W iron $= 12000$ lbs. per sq. in.	
Area of diagonal $= \frac{D_r}{12000} = \frac{V_{r+1} \operatorname{cosec} \theta}{12000}$	... ... $\frac{32571}{12000} = 2{\cdot}7$ sq. ins.

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METHOD OF CALCULATION—*cont.*	EXAMPLE WORKED OUT FOR 40 FT.—*cont.* GIRDER LOADED AS ABOVE—*cont.*
Web Planking.—Average resistance of fir to shear = 300 lbs. per sq. in. *Thickness "f."*—Then "f" × available depth of girder × 300 = R_1 = K.	Available depth = 60 ins. – 10 ins. (approx. depth of boom) = 50 ins. say. $f \times 50 \times 300 = 26400$. $f = 1\frac{2}{3}$ ins. *I.e.* 1-in. planking on *each* side.
Bolts.—Resistance of fir = 1200 lbs. per sq. in. Hence number of bolts × diameter × f × 1200 = K.	Take $\frac{3}{4}$-in. bolts. Number × $\frac{3}{4}$ in. × (2 × 1) × 1200 = 26400. Number = 15.
Nails.—Assume a 6-in. nail has a holding power of 300 lbs. Number = $\frac{K}{300}$.	$\frac{26400}{300} = 88$.

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THE JUNCTION OF THE INDIAN AND RUSSIAN TRIANGULATION WORK IN THE PAMIRS.

(*Continued*).

THE JOURNEY TO THE PAMIRS.

By LIEUT. (NOW CAPTAIN) K. MASON, R.E., *Assistant Superintendent, Survey of India.*

Though the route to Gilgit is well known, it will be perhaps not out of place to describe our journey which was made at a very early time of year when the conditions were very different to those generally experienced in July. We were compelled to start at the earliest possible date so as to take every advantage of the short season during which triangulation is possible and to ensure the due completion of the work.

The detachment may be said to have commenced its journey to the Pamirs from Rawal Pindi, where it left the railway, and took to the road. The party was not yet fully concentrated as Messrs. Collins and McInnes had permission to join at Bandapur and delay had occurred in obtaining sanction for the employment of military signallers from the 9th Gurkhas stationed at Dehra Dun. The morning of the 13th April was spent in loading up the six bullock carts of kit and equipment, and the carts were despatched on their journey of 164 miles to Baramula the same evening.

The next morning we followed by motor, and completed the 198 miles to Srinagar in two days, halting for one night at Domel. The road is too well known to need description, but the luxury of a motor is a great improvement on the old uncomfortable method of travelling by tonga and adds a great charm to one's appreciation of the scenery.

The days which passed in Srinagar while waiting for the heavy transport were busy ones. There were still many things to be bought, and most of my warm and mountain kit had to be gone through, as I had left it in Srinagar in 1912, and it was an anxious time waiting for sanction for the signallers. On the evening of the 19th, the detachment was joined by two Gurkhas on furlough belonging to the 5th Gurkha Rifles at Abbottabad, kindly placed under my orders by Colonel Bruce. Once before, in 1911, I had had two of this famous regiment of mountaineers with me, Kulbahadur and Logbahadur Gurung, and had always found them indefatigable and untiring, and I had learnt to appreciate their fine qualities. The

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two men who now joined me, Kulbir and Hastabir Rana, whom owing to their outstanding characteristics I always connected in my mind with a "rugger" half back and forward respectively, were extremely good and energetic and never once showed the slightest signs of distress or weariness. I can testify that they left an impression of cheerfulness on the whole camp under the most adverse circumstances. Like the men from the 9th Gurkhas, they never failed to set an example of cleanliness and discipline to the motley crowd of mixed races that generally comprised the camp, and one retained the impression throughout, that they were fellow workers and comrades, and that one could treat them as such.

During our stay in Srinagar, Drs. Arthur and Ernest Neve were exceedingly kind in giving us hints, and Mr. Mitchell, who probably knows better than anyone living of the joys and otherwise of the Gilgit Road, having helped to make it some 25 years ago, very kindly made suggestions as to the time we ought to cross the Burzil Pass. We were also the recipients of much kind hospitality from the Resident and Mrs. Stuart Fraser, the former of whom had officially written through to the local authorities requesting them to lend us every support. Without this consideration, it is hardly necessary to add that the progress of the detachment would have been impossible.

On the 25th April, we embarked on *doongahs* and made our way down the Jhelum and across the Wular Lake to Bandapur, which we reached on the following afternoon. Bandapur is the southern terminus of the Gilgit Road, and here all the kit had to be weighed, and arranged into coolie loads. That some forethought was necessary at the start may be gathered from the fact that during the expedition the following methods of transport, ranging from the most modern to the most primitive, were employed; (1) train to Rawal Pindi; (2) bullock carts and ekkas to Baramula; (3) boats to Bandapur; (4) coolies to Gudai; (5) ponies to Gilgit; (6) mules, donkeys, ponies and coolies to Murkushi; (7) yaks over the Mintaka Pass; and (8) yaks, camels and coolies on the Pamirs.

On arrival at Bandapur, we found that our heavy baggage had arrived the same day, and on the following morning we unpacked and laid out everything at the ghât and arranged loads. The same day we were able to send off the heaviest loads in advance, and during the evening Messrs. Collins and McInnes arrived and we made final arrangements for the journey. It had been decided that the detachment should proceed in two main squads, in order to give more room in the huts and bungalows *en route* where the accommodation was very limited and to make it easier to obtain the necessary transport, which was abnormally heavy. The two squads were to be separated by an interval of six days; this would give time for the dismissed coolies returning empty, to help with the transport for the second squad. The deciding factor in the fixing of the

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interval was the length of the Gurais to Gudai stages, as the Gurais district is only sparsely inhabited. The other alternative was to take coolies through from Bandapur to Gudai which would have meant rationing them; and it must be remembered that coolies who live within easy reach of a pass like the Burzil are infinitely better than any who come from a distance, and to whom the districts of the Gilgit Road when under snow recall the miseries of the days so well described by Knight in *Where Three Empires Meet.* Hingston and I were to go with the first detachment and McInnes was to bring along the other. Collins was to go on ahead as fast as possible with only his necessaries to Hunza, to commence the purchase of rations for the whole party.

On the 28th, the first detachment left Bandapur. Lieut. R. Blandy, of the 9th Gurkhas, had obtained permission to accompany us as far as the Pamirs, where he intended to shoot ovis poli, and he kindly undertook the charge of the messing during the journey. We were also lucky in being able to engage Abdulla, a Kashmir shikari, who has had great experience in handling coolies. He was trained by Dr. Neve, and is now fairly conversant with rope work on snow and rock. In 1909 he was chief coolie jemadar to the Duke of the Abruzzi and since then had been with me for three years. He was one of the party on the first ascent of Kolahoi, and a man one could trust.

For some three weeks the weather in the north of Kashmir had been very bad, and we had reports and expectations that the passes would be deep in snow. The evening of the 28th found us at Tragbal, and though ready to start at 2.30 a.m. the next morning, we did not get away behind the last coolie until 4 a.m. We were caught in bad weather on the Rajdiāngan Pass, "The Dancing Hall of the Kings," about 12,000 ft. above sea level, and reached Gorai in the afternoon. Owing to the thickness of the falling snow and the impossibility of seeing far ahead on the pass, I was compelled to take off my skis and one was lost by the Gurkha who carried them. He apparently slipped and fell, and the ski disappeared down the snowy slope, where it would have been useless to follow it as it would have been covered up by the snow and lost before anyone could have found it; it had therefore to be abandoned. Being one of my best pair from Switzerland, it was rather a disaster, and I had to fall back on my spare English pair which were much heavier. These afforded some pleasant running down the valley to Gorai, but though I had crossed the pass on six previous occasions, the uncertain and misty light made small inequalities in the ground impossible to define, and I took a fair number of tosses.

On the 30th April, the weather was fine, and we had a very pleasant march to Gurais. After reaching the Kishenganga River and crossing it at Kanzalwän we turned eastwards up the valley. The scenery here was exquisite; the dark pine forests on the opposite

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side of the valley were slashed with white streaks of avalanche snow. Every bend in the road brought some fresh loveliness in view, and the idea created in the imagination was the perfect harmony of the lights and shades, the colours of the trees and snow.

On reaching Gurais, we called at the telegraph office for any telegrams that might have arrived, and here learnt that the Gilgit mails had been held up for six days on the Burzil Pass. Shortly after arriving at the bungalow, Lieut. H. Whitaker, of the Rifle Brigade, came in. His intention was to shoot in the Astor district, but he was held up for want of coolies. We arranged to move on together, and now our leading detachment numbered over 180 all told. Before starting on the 1st May, a load which had been left behind in the dark at the Tragbal bungalow, arrived. The coolie's performance is worth recording. The load was not missed till our arrival at Gorai, and one of the coolies was sent back to bring it up. Between the hours of 4 a.m. on the 29th April, and 4 a.m. on the 1st May, he had crossed the Rajdiāngan Pass three times, and marched 54 miles in 48 hours, of which 41 miles were accomplished with a load of 60 lbs.—an admirable performance. Surely this is sufficient testimony that even the despised Kashmiri can rise to an occasion when required.

On this day we marched to Peshwāri, just before reaching which place Whitaker came across a four-horned sheep. I was unfortunate in breaking my thermos flask on this march, which I rather treasured as a memory of gay days at Mürren. In stooping to examine a rock the flask which was slung on my back slipped round and struck the ground.

It snowed most of the night we spent at Peshwāri, and as there was very little room in the rest-house buildings some of the coolies preferred to go to a village some 2 miles away. In the early morning the hills wore a mantle of cloud, and the coolies at first refused to stir. By 5.20, however we were away behind the last coolie load. The clouds had cleared, and everything promised a gorgeous day; the new snow of the night before left an exquisite covering on the trees in the valley, and the delicate softness of the snow-stunted birches called forth our admiration. In the early hours of a perfect day, the sublime loveliness of the lacelike tracery of snowladen birch and pine and the filmy transparency of the ghostly vapour clouds rising on the opposite side of the valley, were indescribably beautiful.

Rounding a bend and glancing back, the eye was caught by a small flame-coloured cloud, tinted with the first rays of the rising sun. Suddenly a snow-covered mountain seemed to rise up behind us, rose-coloured, holding us spellbound. Higher the sun rose, and each glance in every new direction seemed to create new sensations. Never had I seen such an exquisite softness, and never, I hope, shall I lose the impression that it made on me.

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We had numerous dead avalanches to cross before reaching Minimarg telegraph station, the highest in the world kept open all the year round. A mile before this the coolies had a narrow escape from an avalanche, which fell between them, cutting off the leading five from the remainder. Owing to our late start, the snow was now getting soft, and as it was deep, there was much plunging amongst the coolies before reaching the shelter of Burzil Chauki. On this occasion my skis were of the greatest assistance to me and prevented me from sinking in, but the numerous avalanche crossings were somewhat tiring.

A night crossing of the Burzil Pass was imperative at this time of the year, particularly as the huge Dam Singh Patthar Avalanche had not yet fallen; and after a short rest the coolies were again moved off at 11.30 p.m. by lantern light. The presence of 180 souls in two huts was not conducive to the height of comfort, so we were all ready for the start. The summit was reached by dawn, the slow progress being attributable to the exhausted state of the coolies who often dropped off to sleep during their frequent halts; this necessitated going round at every halt with a lantern to wake them up and make certain that none were left behind.

My descent of the pass on ski left a lot to be desired, and I came to a bad end at the foot, mainly I prefer to think owing to the hard icy surface of the snow at this early hour. We marched to Chillam Chauki about midday, and most of the coolies arrived the same evening, while the remainder spent the night at Sirdarkōti Dāk Hut. On the 4th we continued the march to Gudai, through a wilderness of white loveliness. Shortly before reaching the bungalow, and after the most impressive scenery imaginable, we had an exquisite glimpse of Nanga Parbat, a sweep of the frailest azure, which even at this distance appeared Lord of the landscape, supreme and unchallenged. On arrival, Hingston attended about 20 cases of minor frostbite among the coolies, the result of crossing the pass with wet feet.

At Gudai we changed transport to ponies and took a day's halt to pay off the coolies and rearrange loads; and on the 6th marched to Astor. After about 3 miles the road crosses to the left bank of the river, and some 5 miles further on recrosses to the right. Up to now the formation had been granite, but just before recrossing we passed some very soft sand rock, finely grained and stratified, evidence of a former life of the Astor River. There were some remarkable alluvial terraces after this, and after again recrossing to the left bank at Gurikōt, we reached Astor about 4 p.m.

The formation here is on a grand scale. Everything is thrown back so that the view is taken in from an immense distance. Astor itself and several patches of cultivation are situated on old levels of the river. The scenery is grand—grander and more rugged and unforgiving than any we had passed till now—savage where before

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it had been soft. The people, too, are in agreement, harder featured and less tame than on the Kashmir side of the Burzil,—in fact the passage of the pass had brought us to a new country, different in scale, in beauty, and in its inhabitants.

On the 9th we marched to Dashkin, and on the next day reached Doyan. The road, after Dashkin, winds up a spur, and on rounding it, we had a fine view of the road keeping to a gentle gradient for some miles. The scale was immense, and it was hard to become accustomed to it. Shortly after this, the road entered the Mishkin Forest, which, with its thick shade and breeze of "softest influence" reminded one of Dante's celestial forest on the way to Paradise. The extraordinary contrast of this charming stretch to the barrenness which we had been passing through, made one realize the truth of Colonel Durand's eulogy in *The Making of a Frontier*. Here, too, I heard a pheasant call.

Suddenly a thunderous roar on our right was heard, and on looking across the valley, an immense cloud of dust and débris was seen to rise. A huge fall of rock had occurred, caused by the sun's rays thawing the ice in the rocks. The southern faces of all these mountains must be eroding very fast, as such falls occur very frequently. Later a smaller fall occurred. The roar of these echoes and re-echoes for fully a minute. A little further on our attention was rivetted on a very fine peak, a true peak it seemed, in the sense that even Ruskin would have allowed. We were told that its name was Ditzil.

On crossing a spur, the vastness of the landscape fairly staggered one. Far away to the west one could see the Indus shimmering in a heat-haze. Winding down our side of the river ran our road, with the Doyan bungalow some 3 miles away. This, owing to the immense scale, seemed but a mere stone's throw. One could imagine in the purple distance the great knee bend of the Indus, cutting its way through the Ladakh Range, and far, far away one could faintly trace the Gilgit Valley approaching its giant neighbour. Away to the right of this, suddenly the summit of Rakaposhi or Dumāni, the Mistmaker, came into view, with her perpetual cloud of snow dust—the only cloud on this perfect day.

It is 18 miles from Doyan to Bunji, but some of this is avoided by going straight down to the Astor River and omitting the zigzags of the road. Some 5 miles after leaving the bungalow, the road cuts into the cliffs of the famous Hatu Pir—one of the most expensive portions of the whole route. By a series of seven zigzags, it ascends a nearly perpendicular cliff over this outlying spur of the Nanga Parbat massif, and on the west side again descends in wide sweeping zigzags to the river at Rāmghāt. A fine view is obtainable from all this part of the road, but to appreciate fully the vastness and grandeur of the landscape, and as Major Bruce writes, "to educate one's sense of scale" one should ascend to

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the top of the hill behind Doyan, a trek of about three hours on a hot day.

Knight, in *Where Three Empires Meet,* gives an awful picture of the miseries of this portion of the road, before it was completed. He writes of the skeletons he passed and of the terror of the coolies. These days are over now, and a 10-ft. road, the masterpiece of the whole route, takes the place of this Golgotha, and makes the journey as near as possible a pleasure.

Colonel Montgomery mentions that in December, 1840, part of the Hatu Pir fell into the Indus, west of Nanga Parbat and formed a dam 1,000 ft. high. A lake formed behind this dam reaching almost to Gilgit 40 miles away. The lake rose 300 ft., and for six months continued to rise, being held back by this natural dam, which it finally burst, and emptied itself in one day, doing an immense amount of damage down the course of the river. A Sikh army in camp as far down the river as Attock was wiped out, " as an old woman with a wet cloth sweeps away an army of ants " ; whole villages were destroyed, and all down the Indus the country was laid desolate.

The gorge of the Astor River where it debouches from the mountains to its confluence with the Indus is very striking, and one crosses it by a fine suspension bridge above Rāmghât or Shaitan Nāra, the Devil's Bridge.

From here to the oasis of Bunji is nothing but a waterless waste — a " crumpled Sahara " as Sir Martin Conway not inaptly calls it. But a fine and wonderful Sahara. Owing to the terror caused by raiding and slave dealing Indus Valley tribesmen, the Bunji Plain has never been repopulated since the disaster of 1841. The new scheme, being carried out by Capt. J. F. Turner, R.E., for bringing a *kul* to irrigate the plains higher up, will turn that part near Safed Parri into a green and fertile land, and if, as has been suggested, the same is done between Bunji and Pertab Pul, and State aid is allowed to returning families, even this stretch of magnificent desolation will become a thing of the past. None of us could grudge a day or two of this, a change in the wonderful scenery of this wonderful road. At Bunji we were handsomely entertained by Lieut. Cole, R.A., who was stationed there.

It was more like the beginning of a good hot weather in the plains than anything else on earth, and we all slept out of doors. Later in the year the Bunji Plain becomes a frightful furnace of almost red-hot sand, which hardly cools at night and on which one cannot bear to rest the hand. On the 10th May, Cole again invited us to breakfast, after which we rode some 6 miles to the Pertab Pul, where we crossed the Indus. Here we said good-bye to Whitaker, as the road to his shooting grounds left our route. He was a great loss to us, and we missed his advice and cheerfulness very much in the days that followed. I could not help wishing that he could have stayed

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with us for the whole trip, for he is an ideal traveller, and one who can always see humour in any situation.

We spent the night in the white bungalow of Parri, and on the next day marched to Gilgit. The last few miles which passed through an avenue of willows were very pleasant travelling, and on arrival we found that Major Macpherson, the Political Agent, had kindly pitched tents for us in the Agency Gardens. We halted some days at Gilgit and these were full of work. Collins went on and McInnes came through and also passed on. Equipment, which had been left in store here from last year, had to be taken over, tents and kit repaired and finally a depôt and office established here. A point in the arrangements which we had overlooked, but which was remedied on the suggestion of a local tailor, was the necessity of one of his trade to accompany us to repair tents, etc. We engaged one Shukra, who carried a light load on the march, and about every other day or so kept the tents in repair. This is the only method of keeping them fit for habitation in the sort of climate we had to expect.

We had to dismiss our ponies as Gilgit could not support them even for so short a period as a week, and difficulties were met with in obtaining fresh transport. However, with a mixture of mules, ponies, donkeys and Balti coolies, we moved away on the 17th. Major and Mrs. Macpherson were very kind and hospitable during our stay in Gilgit, but much of their hospitality we were obliged to decline owing to the necessity of pushing on. Our detachment was in camp near the graveyard, below the Treasury, in a delightfully shady garden known as Hayward's Bagh, and we took the opportunity of visiting Harry Bell's grave. He is buried next to Hayward, the intrepid Himalayan traveller, who was murdered in Yasin and finally brought in to Gilgit and buried there. Capt. J. F. Turner, R.E., kindly took charge of the memorial stone, which I had brought from England, and undertook to build the monument desired by his people.

On the 17th May we spent the night at Nomal, and the next day reached Chalt. The road is still wonderful—" a knife-scratch across the harsh face of desolation, whose dominant features of rock and stone and sharply jutting spurs were unredeemed by the least suggestion in outline and tint." Perhaps so, but though slightly wearisome there was always the splendour of some wild crag, or some fascinating virgin peak to engage the attention. It is between these places and in the desolate gorge through the Kailas Range, that the Hunza River cuts its way across the main axis. And now one could realize the extraordinary achievement accomplished during the Hunza-Nagar campaign when a field force was taken through this defile, before this road was completed. One had only to see the road and the numerous discarded remnants of road to realize the anxiety of having to keep this kind of country open for communi-

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cations, with enemies on all sides and in rear, and only to glance at the famous Chaichar Parri to realize the key to this defile on the north.

The 19th was another perfect day, and another which will be difficult to forget. Not half a mile from Chalt the attention is rivetted by the spear-shaped summit of Rakaposhi, or Dumāni as it is called on the Kanjūt side. It was unearthly, ethereal, sublime. Miles of glittering ice and snowclad slopes, leading to its sunlit crest, seemed ready to thunder down destruction on anyone daring enough to attempt an ascent.

"Such things are not to be seen lightly, nor would one wish that the toil and the trouble could have been abated. The memory of these wonders of the earth is a priceless possession, none the less precious because one has waited and endured somewhat to obtain it. A lasting regret there is—that one has seen these things, and must remain for ever inarticulate. It is one thing to see a pale white shape, faintly gleaming against the blue sky, and quite another thing to express the grip it takes of the heart and of the imagination. A stony, colourless plain, and, far beyond, a dim shaft of light like a broken spear projecting above the horizon. Yet how much is suggested—a vast bulk hidden from view, long miles of snow-clad slopes, immeasurable cubic yards of green ice, the covering the accumulation of centuries, the thing itself a monument to some convulsion of Nature, dating back into years beyond comprehension. A thing of perfect serenity, looking down on a world with placid calm; yet one knows how the wind rages among its pinnacles, and how the storms of winter howl like wild beasts in its ravines. The mother of rivers that nourish millions of humanity, the progenitor of floods that wipe out human endeavour as if it were writing on a slate. A jewel in the sunlight, and a terror in the darkness. Its head poised in the uttermost limits of the air we breathe, its feet in the bowels of the earth, where are generated the catastrophes that shake the world."

Thus writes David Fraser, and no lines could better apply to the entrancing vision we beheld that morning.

It is difficult to believe that until some 20 years ago this romantic valley was the scene of perpetual strife and petty wars, Hunza and Nagar always at war with each other or combined against some common foe, in protection of their lands. If only the Mistmaker could tell us of the horrors, of the murders, and of the miseries of the old slave days, we should hear a history of tears and weeping. Then came the Russian tentacles, Capt. Gromchevtsky and his Cossacks, and the "slamming of the door"; the British advance, the storming and taking of Nilt Fortress and of the almost impregnable position beyond.

We made a long détour up the Burdelas Nala and down again by its left bank. For a time our "jewel in the sunlight" was hidden

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and then we had one perfect view as the mistladen vapours rose and covered her.

Crossing the river at Sikanderabad to the Nagar side, one immediately enters the land of forts. That of Sikanderabad itself crowns the *parri* guarding the bridge. Under the shadow of this we passed, and some 3 miles further on came suddenly on the historic fortress of Nilt.* Kulbir and Hastabir were very interested in the deeds of their fathers, and I tried to explain to them the part the 5th Gurkhas took in the capture of the stronghold. The remains of the blown-up gate are still visible and the rabbit warren of dwellings within still inhabited. After Nilt Fortress came Thōl Fort, and then Gulmat —every village a regular stockade. Yāl Fort and that of Pisan follow in close succession, both at the foot of glacier valleys sweeping down from Rakaposhi. Lastly we arrived at Minapin after a march of 21 miles, and put up at the bungalow.

The 20th was a busy day. After sending off the camp to Aliabad, we visited the Minapin Glacier, which had been measured by Mr. H. H. Hayden, of the Geological Survey, in 1906. This was remeasured and the results will be found in Chapter VII. The march on this day rather lacked shade until we crossed the Hunza River to the right bank, after which the views became indescribably beautiful. Shortly before reaching Aliabad, we diverged up the Hassanabad Valley and examined the snout of this glacier and Mr. Hayden's marks.

The Mir of Hunza and his retinue of scallywags were awaiting us at Aliabad, where for the first time the whole detachment was concentrated. Two busy days followed, sorting out the various kit, and distributing the equipment to the three detachments, and on the 22nd a visit was paid to the Mir in his castle at Baltit.

The enormous amount of energy and skill spent on the original laying out of the cultivable terraces of Hunza strikes the traveller at once, the whole consisting of small fields of land, built up and retained by carefully made and picturesque walls. It must have taken centuries to retrieve all this land for cultivation, and an engineer of no mean powers to lay out the fields and plan their irrigation. Two canals were originally made, but that which took off from the Hassanabad Glacier below Aliabad, and which was brought back some miles along the cliff, has been put out of action by the sudden advance of the glacier some years ago, and it is almost heartrending to see the remains of the old terraces, built up with such care, now lying desolate.

The Hunzakūts were very short of agricultural implements, and I was tempted to write for sanction to sell our large stock when the work was finished, as their actual worth would not really balance

* For an official history of this campaign, see *Frontier and Overseas Expeditions from India*, Vol. I.

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the cost of their carriage down the road, while if left here they would be of great use and highly appreciated.

At Aliabad we decided on the strength of each squad, and enlisted the permanent coolies. Amongst those I took with me to the Pamirs, I included 25 Baltis, selected men, whom I knew I could trust. The Balti, being Shiah Mahomedan, does not employ the Ladakhi custom of polyandry to check the increase of his population, but on the other hand has decided polygamous tendencies, with the result that his poor country cannot afford to support the entire population, and emigration is the only alternative. They are the most faithful and trustworthy coolies in the world, will do anything they are told to do, unless fear takes hold of them; and they are extremely hardy and can withstand an enormous amount of cold. They are a race of children, and look on their employer as their father; and it is easiest to get them to work well if one treats them as such and looks after them carefully. The Kashmiri coolie requires a totally different treatment; he is a servant, knows he is a servant, and must be treated as a servant, or else he will impose on his master, sham illness on every possible occasion, and will give endless trouble. Again, the Kanjūti of Hunza has to be treated differently. He believes in Liberty, Equality, and, if it pays him, Fraternity. He requires it to be known that his master places implicit trust in him, admires his manly qualities and bearing, and treats him as one on a higher social plane than the rest. He will then live up to the standard required of him; he is a wonderful mountaineer on rock, and the best of them would probably never own defeat in this particular form of climbing, though they are not so reliable on snow and ice.

On the 23rd, after some preliminary troubles, the Pamir squad moved off. As has been mentioned in Chapter I., the arrangement was that I should travel straight to the Russian stations, and from there work back to the Kilik Pass; for Collins to work up the Hunza and Chapursān Valleys, while McInnes commenced by reconnoitring the country between us. The road ceases at Hunza; beyond it degenerates into a rough track impassable to ponies. In places it consists of stones laid on pegs driven into the face of the cliffs, but after passing Mahommedabad, we found that we were still able to use the winter route and to come down to the river bed. The gorge is very grand and rugged, and we occasionally had to climb *parris* or cliffs to avoid stretches of the river. A few of these with which to finish the march brought us again to the river bed below Atabad, where camp was pitched for the night.

The next day the detachment marched to Gulmit. For part of the way we were able to keep to the valley, as the Hunza River had not yet risen to its summer dimensions, and we were able to avoid the appalling *parri* at the beginning of this march, which greeted us on the return journey. Several of the strips of the "road" were

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however distinctly interesting, but none quite so nerve-shattering as we had been led to expect. Near Bulchidas and opposite the Brondibār Nala, the track rises steeply over the Salāmitas Parri, and in places barely exists; from the summit of this *parri*, a very imposing view was obtained of the Shoonuk Mountains beyond Pasu.

At Gulmit I was able to obtain Harry Bell's ovis poli head, which had been brought down during the cold weather, and which I eventually despatched to his father in England. Here also the Mir had a large storehouse, where we had arranged to take over 60 maunds of *ata*. After weighing out and sealing up the bags, we left on the 25th for Pasu, and passed the snout of the Sasaini Glacier, which at present approaches to within about 300 yards of the left bank of the Hunza River. The track here climbs on to a tongue of land on which is situated the village of Sasaini, and then crosses a broad belt of slates at the top of which is Baurit. From here one sees a long lateral moraine placed high on a solid cliff foundation, which must have been formed when the Pasu Glacier advanced far into the bed of the Hunza River.

The next day's march took us across the large Batūra Glacier, which is said to be about 20 miles long and 1½ miles broad. We did not have time to go down to the snout, which we were told runs well down into the Hunza River. The track crosses it about three-quarters of a mile from the snout and the glacier is here cut up somewhat by transverse crevasses, which, however, were closed up and presented no difficulties.

Almost directly opposite the Batūra Glacier the famous Shingshal River meets the Hunza. This was one of the main raiding routes of the Kanjūtis in the days when they used to raid for slaves into the Valley of Raskam, which they completely depopulated. We reached Khaibar about 3.15 p.m., and found the lumbadar and his very old father awaiting us. The latter, who gave his age at 100, was easy to draw out on the subject of his wild youth. Four times, he said, he had raided for women, but though his eyes glistened at the memory of the good old days, he admitted that he was glad of the Pax Britannica in his old age.

The village of Khaibar is seemingly quite impregnable. A stream has cut its way down the mountain side to the south, and a zigzag path winds up to the fan on which the village is situated. At the top of this track, there is a gate with a mud citadel called the "*Darband*." In former days the garrison used to drop down rocks from here on to the heads of intrepid attackers below. This is the defence on the south side. On the east the fan drops sheer down to the river beneath, forming an unscalable wall on this side. On the west the hillside is fairly difficult, and on the north there is a *darband* similar to that on the south. Our centenarian friend said that he could not remember on how many people's heads he had

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rolled stones, as he had not kept a *hissab*, but certainly very many. Here we managed to purchase six more maunds of *ata*.

On the following day we marched to Gircha. About a mile after leaving Khaibar we crossed to the left bank of the Hunza River by a fairly substantial bridge. The march from here to Gircha was easy, a total of only 10 or 11 miles. During the afternoon the signallers showed their mates how to show a steady light for observations, and I put in some time cleaning and adjusting the theodolite. Hingston went off to look for fossils, but without success, and in the evening we weighed out and sealed up another 60 maunds of *ata*.

On the 28th May the march was somewhat more tiring. After an easy march to Sōst, we dropped down to the river bed, and were able to avoid some bad *parris*. Here the Chapursān River joins the Hunza, which above the junction is much smaller. Between here and Misgar, we had to ford the river ten times in all. The men of Hunza and Little Gujhāl are the most powerful forders I have ever met. I was not a little surprised that the men, though Mahommedans, "girt up their loins" to above the waist, took off their bifurcated habiliments and crossed very nearly in a state of nature; but I see in Colonel Durand's *The Making of a Frontier* that the Chitrali footmen shocked his Pathans very much "by rolling up their voluminous skirts, taking off their *paijamas* and fording stark naked." Colonel Durand adds that they are the only Mahommedans he has ever met with who will do so unashamed.

The first seven fords were comparatively simple, though one pony fell and gave a Hunza levy a ducking. The eighth was more difficult, the Hunza River running swiftly through vertical walls, the gorge being cut by the combined influence of the Kilik and Khūnjerab Rivers which join just above. Two more easy fords after this, with the intermediate road near the river bed brought us to a large conglomerate flat, after traversing which the track wound down to the river and crossed by a bridge a mile short of Misgar. It then winds up to the corresponding flat on the other side, and on this is situated the village. The level of these flats evidences the top of the deposit laid down formerly by the Kilik River, which has since been rejuvenated, and has cut its bed down again through a depth of some 360 ft.

Shortly after our arrival in camp, we were visited by a cyclone of terrific violence. One double-fly tent and two of the khalassie's tents were levelled and one coolie "wigwam" in the course of being erected was blown inside out, and the framework was smashed. The cyclone was followed by heavy rain.

High up in the cliffs above Misgar, there are some curious old caves. Hingston visited these by being hauled up on the rope; he found them to be of artificial construction, and though he dug up the floor he could find nothing of any interest. They were of enormous size and were capable of containing 100 men with ease. They

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appear to have been used as hiding places during the old inter-tribal raids. Anyone trying to reach the entrance had a stone flung at his head, and they were probably quite impregnable so long as rations lasted.

On the 29th May we marched to Murkushi, the road gradually descending to near the river bed. A very cold wind was blowing as we reached Tōpkhāna, near which place the Derdi stream enters by the right bank. Tōpkhāna consists of a single small square look-out, again reminiscent of the old fighting days.

Strictly speaking, the Chapursān River, and not the Kilik or Mintaka should be considered as the head-waters of the Hunza. The Chapursān lies in the longitudinal trough between the Karakoram and the Northern Hindu Kush, which latter range has been cut back into by the Kilik and Mintaka, and the Chapursān is longer by many miles than either of these two streams, which should be properly considered as only subsidiary tributaries. The Ghūjerab and Khūnjerab, though only very imperfectly explored, lie also in this trough to the east. A curious point about the nomenclature of the rivers in this district must be mentioned to avoid confusion. On both sides of the Kilik Pass, the rivers flowing from the water-shed are called the Kilik River, that on the Pamir side being generally designated "Jilga." Similarly at the Mintaka, Kharchanai, and Khūnjerab Passes.

Considering the Chapursān as the source of the Hunza River, geographically speaking it possesses one of the most curious attributes of all rivers of the globe. Its waters cut through seven ranges. Rising south of the Northern Hindu Kush and Northern Karakoram Ranges it flows eastwards in a longitudinal trough till it meets the Khūnjerab, flowing in the opposite direction, and in the same trough. At this point it bends southwards at right angles, and the combined waters attack the great Karakoram and cut their way successfully through the solid granite of this stupendous range, in one of those magnificent gorges so typical of this great barrier scenery. South of the Karakoram axis, on being joined by the Hispar, which drains the longitudinal trough between this range and the Kailas Range to the south, the river flows westwards of Chalt, where it again bends south through a right angle, and attacks the Kailas Range, cutting it at the striking gorge of Chaichar, 9 miles west of Rakaposhi, 25,550 ft., the bed of the river being at a height of only 6,000 ft. above sea level. The Hunza River continues southwards through this range to within a few miles east of Gilgit, where it is joined by the river of that name, which has drained the westerly trough between the Kailas and the Ladāk Ranges. The combined waters of these two rivers now flow for some 30 miles in an easterly direction, where they meet the great Indus, which, as becomes a river of this magnitude, has undergone two successive struggles with the Ladāk Range already, and which now, with the aid of the Hunza

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and Gilgit Rivers, attacks the range for the third time. South of the Ladāk Range, and below Bunji, the Indus is joined by the Astor River, draining the Ladāk—Himalaya trough, and cutting its tortuous way through the Himalaya, west of the mighty Nanga Parbat, and through the lesser ranges to the south, it flows unconcernedly to the sea.

The march to Murkushi was desolate in the extreme. A few—very few—trees, and for the rest, huge granite boulders and river-cut conglomerate, possibly the remains of an ancient Pamir. At Runhil 11,680 ft. above sea level, another oasis of trees near the river bed was passed, which scarcely merits a place on the map. Murkushi itself is more deserving of honour, though one scarcely realizes this fact on the outward journey, but only when one has been without the sight of a tree for a couple of months.

At this place we had the pleasure of renewing our acquaintance with M. Reweliotty, the Russian Consul-General, who was passing through on his way to Russia by way of the Pamirs, and with whom we had a hare shoot. Here we were delayed by trouble with the yak-transport, and on the 30th May spent the day paying off coolies and making up accounts to the end of the month.

The following day, we completed the short half march to Boihil, while our permanent coolies made the journey from Murkushi twice to bring up the remainder of the equipment. At last some very tired yaks arrived and took some of our kit another short half march to Gulquāja, at the snout of the Gulquāja Glacier, where there is a stone dâk hut. Some of the kit had already gone on here by coolies, but some of the *ata* had still to be left at Boihil.

On the 3rd June, at last we crossed the Mintaka Pass on to the Taghdumbash Pamir. As we ascended the pass, Mahomed Beg, the British representative, accompanied by more yaks, was met with, descending on our side, and with these animals most of the remaining kit could be brought up, only leaving some loads of *ata* to be brought up later.

The crossing of the easy Mintaka Pass, some 15,000 odd feet, marked the end of the first stage of the work; and nothing could have been more pleasant than the wonderful scenery we had passed through. It appeared as though Nature had been asserting herself for some final and supreme effort of magnitude, and had failed, and the desolation of the Pamirs was her revenge. We completed the longish march to Mintaka Akhsai, where Mahomed's camp was located, and were soon comfortably installed in his guest khourga—a substantial building of skins and mats laid on a framework of wood, the floor being spread with carpets from Yarkand.

On the following day we established a depôt here, and ascended our first station to reconnoitre.

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REVIEWS.

HISTORY OF UNDERGROUND WARFARE.

Being a Review of the book by A. GENEZ, Captain of Engineers, French Army.—(Librarie Militaire Berger Levrault, Paris, Rue Des Beaux-Arts 5–7, 1914. Price 5 francs).

(*Continued*).

THIRD PERIOD.

The Siege of Candia demonstrated the importance of subterranean defence outside the fortress, and from 1670 all new fortresses had systems of countermines under the glacis, with listening galleries in masonry. Numerous systems were devised, but so far there was no rule for determining the weight of the charge with reference to the direction of its explosion, and to the weight and nature of the material to be moved. With Vauban a scientific spirit was introduced, and under his directions Mesgrigny undertook various experiments at the Siege of Tournai.

From these experiments it was wrongly deduced that however much the charge was increased the radius of rupture was always the same as that of a common mine, the only difference being that the materials were expelled with greater force. This error prevailed for half a century, when Belidor demonstrated the properties of overcharged mines; possibly the effects produced by large mines at Luxembourg and Turin suggested to him the need for further experiments.

At Luxembourg (1684) Vauban directed the siege works, assisted by several Engineers. The principal attack was directed against the Barlemont Bastion, which was itself protected by a counterguard, the escarp wall of which was 13 ft. thick at the base. Behind it was a masonry gallery 10 ft. high and 10 ft. wide. The whole was demolished by 22 charges of 440 lbs. each placed 4 ft. from the exterior face of the wall, and 15 charges of 385 lbs. each placed in the earth behind the inner wall of the gallery, which was 4 ft. thick. These charges must have been 12 ft. to 16 ft. below the top of the parapet, and 25 ft. to 30 ft. apart. The width of the breach opened was about 500 ft., the largest hitherto made by mines.

In 1706, during the Wars of the Spanish Succession, the French besieged Turin, which was held for the Duke of Savoy. The garrison was strong, the inhabitants were devoted to Savoy, and the fortifications had been improved by Vauban, to whom the King wished to entrust the conduct of the siege, but Mme. de Maintenon secured it for her son-in-law, the Duke de la Feuillade. Vauban would first have taken the Capucin Heights, on the east, or right bank, of the Po. They commanded the city, which was situated on the left bank. His scheme was sent to

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la Feuillade, but the latter preferred his own, which was to capture the Citadel on the West Front. He had attempted to do so once before, and the Duke of Savoy, forewarned, had recently constructed lunettes in front of the citadel with a countermined glacis in front, had divided the citadel into two parts by a retrenchment, and protected the bastions by counterguards.

The French sent a fine army, with a numerous artillery, eight brigades of Engineers commanded by Tardif, and four strong companies of miners. From right to left the front attacked comprised the Amédée and St. Maurice Bastions of the citadel, with the demilune de Secours opposite the curtain between them covering the Secours Gate, then the Royal Bastion, the demilune of the Susine Gate, and a hornwork protected by a flèche, the last three being a part of the defences of the town itself. The countermines of the defence in front of the citadel were of masonry in two tiers, the upper tier being on a level with and entered from the ditch. There was also an improvised system, constructed since the siege had been threatened, in front of the other works mentioned. Every precaution was taken to organize a system of listeners, arrangements for firing mines, and materials for repairing damages.

On the twenty-fourth night of the siege the French commenced a gallery 50 yards from the Amédée Bastion. Progress was only 4 yards a day owing to the sandy ground and to damage caused by shells, and on 5th July a mine was fired, which did no damage to the countermines, but formed a crater which was crowned. On 21st July another mine was fired 10 yards from the salient of the flèche in front of the bastion, the flèche was carried, and the powder hose leading to the defenders' countermines was cut. Next day the defenders fired a mine, which they had prepared low down in the flèche, and drove off their assailants who, however, recovered the flèche by a counter-attack.

Here the 4th parallel was opened, and shafts sunk to 38 ft., the level of the defenders' lower tier of countermine galleries, which were broken into on 4th August, and the powder hose severed. The defenders erected a barricade which was blown down on the 8th, and the further progress of the besiegers was only prevented by throwing earth and bombs down a ventilator and so blocking the gallery. On the 16th and 27th August the defenders blew up batteries placed to fire on the demilune de Secours, but, compelled gradually to retreat, they prepared countermines under the position of the expected breach, and fougasses in the ditch.

By the advice of Vallières, Commandant of the Miners, the French had commenced two galleries with the intention of blowing in the flèche of the demilune de Secours, but these were discovered, and on the 14th July the Piedmontese fired a countermine which broke up both galleries and buried miners and grenadiers. The air in the galleries was so bad for some days afterwards that they could not be entered again until fresh air had been pumped in by forge bellows connected to tin tubes.

On the 21st July the French blew up a palisade and captured the flèche, and next day discovered a ventilator which appeared to lead to the defenders' lower countermine gallery. Careful investigation showed the possibility of excavating a channel and bringing water about 1,200

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yards to flood this gallery. This work was finished on the 3rd August, and the water turned on. On the 9th the lower gallery was opened, and it was found that the inundation had prevented the firing of several mines. However, the defenders had blocked the gallery and not much progress was made.

On the 13th July, before capturing the flèche of the demilune de Secours, the French had managed to find and break into the defenders' upper countermine gallery. They were on a higher level, and lowered three men one after the other, who were shot at once. A man with a shield then went down and managed to place some sandbags to cover the descent of others, and a hot fire was carried on until the smoke made the gallery uninhabitable.

The French had now reached the gorge of the flèche and, after a few mines had been fired by the defenders with little effect, were lulled to a false sense of security in the hope that their inundation of the lower gallery had produced the desired effect. They forgot the upper tier of galleries to which the Piedmontese still had access from the counterscarp gallery of the demilune de Secours. A battery of 16 guns and some mortars was established on the flèche, whereupon the defenders drove four branches under it, on the level of the ditch, from the counterscarp gallery. On the morning of the 24th the French were firing their first salvos, and looking for the early fall of the walls, when the four mines were fired, and destroyed all but three of the guns. The attackers fled, many falling under the fire from the walls. Some of the damage was repaired that night, and on 25th four guns opened fire, two of which were destroyed by a fresh mine. On the night of the 26th an assault was made on the demilune and the two bastions, the counterscarp was blown down, but the escarp had hardly been touched, and the attack failed.

It has been said that the upper countermine gallery was entered from the ditch. A ladder led to the lower gallery. On 29th August four French miners with shields descended into the ditch, and managed to reach the entrance to the gallery. They were killed by the guard, and three more met the same fate. A dozen more followed, and overcoming the guard, obtained possession of the entrance. A mine had been prepared in case of need, and as the guard retired by the lower gallery, the last of them, Pierre Mica, set fire to the hose. The explosion killed him, but also killed all the assailants. A monument was afterwards raised to his memory in the arsenal.

On the 31st August a second general assault was attempted and again failed. During the action the defenders fired a mine under the re-entering place of arms, between the Amédée Bastion and the demilune de Secours, destroying two guns of a 4-gun battery, and almost annihilating two companies of grenadiers, the survivors of whom fled. The remaining two guns were destroyed by the Piedmontese, and one gun which had been blown into the ditch was recovered and mounted in front of the Governor's residence. One of the defenders' mines under the place of arms had failed to explode. This was rectified, and the mine was fired on the 5th September, when two guns which had recently been brought into action were destroyed.

The subterranean battle in front of the Amédée Bastion proceeded

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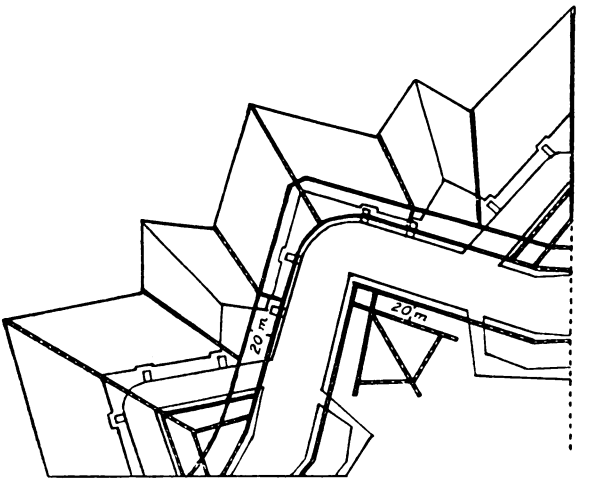
all through the siege, but presents no interesting features. It was less vigorous in front of the Susine Gate and the hornwork. Some mines of the defenders had delayed the attackers' works there, and they concentrated all their efforts against the citadel, which was the key of the position.

At the end of August a French field army, under the Duke of Orleans and Marsin, took refuge in the besiegers' lines, but la Feuillade would not attempt a general assault, and gave time to Prince Eugène and the Duke of Savoy to cross the Po, and attack the field army, which was defeated. la Feuillade tried to intervene, but in vain, and was forced to raise the siege, after destroying his magazines and abandoning his artillery.

It is undeniable that the system of countermines prepared beforehand saved Turin, and although the defenders were short of powder they used their resources to the best advantage. la Feuillade's plan had been anticipated and provided for, and though several engineers besought him to accept Vauban's scheme, he was too proud to do so. His engineers deserve all praise. They sacrificed themselves to secure the success of a plan in which they had no confidence. Vauban himself offered to serve under la Feuillade, but Louis XIV. would not permit him to do so.

Count de Mesgrigny, who had served as an engineer in numerous sieges, was appointed in 1668 King's Lieutenant of the Citadel of Tournai, which was then being constructed. He there carried out the system of countermines which bears his name. The town was defended by a simple enciente, with the addition of a citadel of five bastioned fronts, having demilunes between the bastions, and tenailles in front of the curtains.



System of Countermines of a Front of the Citadel of Tournai.

de Mesgrigny employed two escarp galleries, one close behind the revetment wall from which to advance to meet the enemy and dispute the passage of the ditch. This gallery was prolonged under the tenailles

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to prevent the system from being turned. The second gallery was 25 yards in rear, and was intended to facilitate blowing up lodgments formed in the breaches. There were other galleries in the bastions for a step-by-step defence.

In the demilunes were two similar escarp galleries, and the mine defence of the interior was secured by prolonging the main counterscarp galleries. One of these ran under the covered way and the gorges of the demilunes, the second was 25 yards in front of it, and there were listening galleries running out under the exterior and interior angles of the glacis. No bastion or demilune could be taken without being breached, and to effect that the covered way must first be crowned; the second, or outer gallery, was to prevent this crowning. When that gallery was destroyed, the gallery under the covered way would enable the batteries overhead to be blown up, delay the breaching operations, and prevent a descent into the ditch. The only defect worth mentioning was the want of a counterscarp gallery in front of the demilunes.

Tournai was invested at the end of June, 1709, by Prince Eugène and Marlborough. Favart directed the engineering operations. There was no reserve of provisions in the fortress, the garrison of 6,000 men existed on what they could extract from the inhabitants, which was only grain, and the necessity of using water for grinding it prevented the ditches being flooded. The Allies were 50,000 strong with numerous artillery. Trenches were opened on the night of the 7th of July, on the 29th the town capitulated. The citadel held out longer in order to keep a besieging army occupied, and prevent it from joining the field army.

de Mesgrigny was 80 years old, but insisted on directing the operations. He had only 52 miners; the besiegers, under Count de Lottun, had 200 of the Piedmontese who had all served at the defence of Turin. The attack was directed against one front, and half the two adjacent fronts. Early in August the defenders made a sortie, and remaining in the covered way enticed the besiegers over three mines in the glacis, which were fired, and shortly afterwards some of the besiegers' works were damaged by mines.

On the 8th another body of troops under General Schulembourg arrived and attacked the citadel on the opposite side. The countermine defence was so active that neither attack could make much headway. On 13th August de Lottun's troops carried the covered way and managed to enter one of the countermines, where they found, and destroyed or removed, 4 tons of powder, but, in spite of this, explosions of other mines compelled them to vacate the covered way. A similar attempt on the 15th met with the same result. On the 16th the Allies on the opposite front managed to penetrate a countermine gallery and establish themselves there, but were checked by a barricade. This was their first real advance, for not being able to secure the covered way, they were unable to breach the escarp, of which the edge only was visible from their batteries. Their mines had hitherto been of little effect.

On the 19th two battalions were annihilated in their trenches by countermines, and on the 20th several soldiers and miners were crushed in the ditch by the blowing up of part of the wall of the town. On the 23rd the gallery which had been captured by the Allies was blown in,

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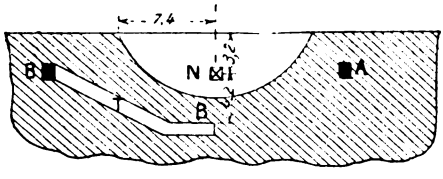
and several miners were suffocated in it. A battery of mortars erected by the assailants between the town and the citadel was next blown up, but a sortie following on this success was repulsed, and the besiegers were only prevented from entering the citadel by the explosion of another mine, which however also killed a number of Hanoverians.

On Schulembourg's side the besiegers now established a battery on the covered way, and as they had previously exploded a mine on the site of their lodgment, considered themselves secure. However on the 24th a portion of the guard in the trenches was blown up. On the 26th the bursting of a mine exposed several countermines, but the defenders blew up part of the ditch on the town side where 800 of the besiegers had assembled. Many of the besiegers' miners deserted, and were sheltered by the inhabitants in spite of the dire penalties which were threatened for such behaviour.

Failure of provisions led to the capitulation of the citadel, and the garrison on the 3rd of September was allowed to depart with the honours of war. The underground war had lasted 51 days, and this lengthy defence, in the face of famine, was entirely due to de Mesgrigny's countermines.

Amongst the engineers who have made the corps of miners famous, Belidor is the most celebrated by his efforts to uproot the "invariable crater" myth. He was professor of mathematics at the school of La Fère, and evolved the theory that increasing the charge of a mine increased almost indefinitely the radius of the crater. He called his mines "globes of compression" and in 1725 commenced experiments to prove his theory, which had been vehemently attacked by many engineers led by Vallières, Director-General of the Artillery College.

He dug four shafts, C, D, E, F, 10 ft., 11 ft., 12 ft., and 13 ft. deep respectively at the angles of a square of 24 metres side, and joined their



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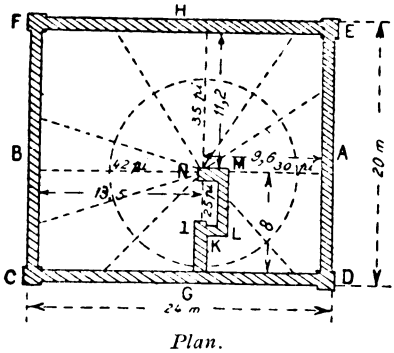

Plan.

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bases by four sloping galleries each 1 m. wide by 1·44 m. high. These were lined with oak, and had been excavated in compact clay, except that the bottom of Shaft C was in a wide and deep bed of hard marl. A mine N, 10 ft. deep, was placed at the end of a cranked gallery. The centre of the charge was 8 m. from the gallery CD, 9·6 m. from DE, 11·2 m. from EF, and 13·5 m. from FC. A branch ramped gallery T was excavated having its top 4·2 m. below the centre N. According to Belidor the charge for a common mine should be 100 lbs. of powder; he fired 13,200 lbs. The radius of the crater was 24¼ ft., more than double the line of least resistance. All the galleries were staved in for lengths "almost in inverse proportion to their distances from the mine." The gallery beneath was broken in, also the two shafts D and E nearest to the explosion.

The success of this experiment did not convince his opponents, and in 1753 Louis XV. directed that official trials should be made at Bizy. These were carried out, in the presence of many distinguished officers, practically on the same lines as Belidor's, except that the galleries were lined with masonry. The mine was 13 ft. below ground, the crater was 17 ft. deep, and 66 ft. in diameter. The charge had been 3,000 lbs. The galleries were all shattered for nearly their whole length. Little impression was made in France by these experiments, and the celebrated engineer, Delorme, did not profit by them at the Siege of Berg-op-Zoom, but abroad, especially in Germany, the results were received with enthusiasm. Lefevre, who was in service with the Great Frederic, repeated them with like results at Potsdam, and applied them at the Siege of Schweidnitz.

In 1747 a French army under Count de Lowendhal laid siege to Berg-op-Zoom, which had been fortified by Cohorn, and was reputed impregnable. The attack was directed against the front from the Cohorn Bastion to the Pucelle Bastion. Opposite the curtain was a large demilune, flanked by two lunettes. There was a covered way 22 yards wide in front of all these works, which were revetted and had dry ditches. The countermine system consisted of a main counterscarp gallery from which led four listeners about 45 yards long. It was reached by gates opening on the ditch, and by two galleries from the demilune, passing under the ditch. Cut stone troughs had been provided for the powder hose.

The underground warfare presents few features of interest. It began on the night of 26th July (thirtieth of the siege) and by 16th September the counterscarp walls opposite the right flank of the Pucelle Bastion, the left flank of the Cohorn Bastion, and in front of the demilune, had been blown into the ditch, both lunettes had been captured, and there were two breaches in the escarp walls of each bastion, and one in the escarp on the right of the demilune. A general assault through the breaches, by escalading, and by the postern gate, was delivered on that day, and the place was captured.

Four-fifths of the total length of the siege was occupied in crossing the glacis, and as during all that time a violent fire of musketry, guns, and mortars had been maintained, a large proportion of the fatalities of the besiegers may be attributed to the slowness of their works, due to the defenders' countermines. At the same time the sandy nature of the soil presented almost insuperable difficulties to the engineers of the

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attack, from a great deal of which the defenders were saved by their masonry galleries. The latter do not seem to have extended their galleries at all until after the commencement of the siege, but, knowing the treacherous nature of the soil, had collected large stores of oak mining cases of a pattern which afterwards came into general use under the name of Dutch cases. It is worthy of note that at this siege the French did not repeat the error they committed at Turin, but took care to clear the enemy out of the ground beneath before they established their breaching batteries. Only the epaulment of one of their batteries was damaged by mines.

A rapid method of sinking shafts introduced by a Capt. Boule was made great use of for reaching the base of the counterscarp walls and blowing them down. A shaft of about 18-in. side is excavated by means of spades, or scoops, shaped like a hoe, with handles from 3 ft. to 18 ft. in length. The earth is dragged out by baskets attached to a rope. When at the required depth a box is lowered filled with 150 lbs. to 200 lbs. of powder, the hose is fixed to one side of the shaft, the earth is thrown back and rammed to tamp the charge, and the mine is ready to fire.

In 1762 a Prussian army under Frederic the Great arrived to recapture Schweidnitz, which had been taken by surprise by the Austrians the year before. Trenches were opened on 7th August. The attack was directed against three of the exterior forts, that against No. 2 being the principal. The forts were of star trace, with dry revetted ditches, and the intervals were organized for defence. A covered way, with a wall outside it, ran continuously along the front of forts and intervals.

Five countermine galleries ran from the three front salients of Fort 2, and from the two re-entrants between them, reaching to beyond the toe of the glacis. Each gallery from the salients branched into three, each of which ended in a tee, and the galleries from the re-entrants also ended in tees. By this means the whole front was embraced. The mine attack was limited to the ground round the central salient system of galleries only.

Under the direction of Lefevre mining began from the third parallel on the 22nd of August, and on the 28th had advanced about 85 ft. when the defenders made a sortie, discovered the entrance to the mine which they filled with bombs, stink balls, and barrels of powder, and blew up. The sortie then retired with several prisoners, from whom details of the mine scheme were obtained. It was calculated that the galleries would pass about 7½ ft. below the countermine galleries, and measures were taken accordingly. The besiegers repaired their damaged gallery, but on the 30th having advanced about 100 ft. had to stop for want of air. It was decided to charge a mine chamber with 5,500 lbs. of powder with L.L.R. of 17½ ft. Tamping was completed on the 1st of September, and the first "globe of compression" was fired. A crater 20 ft. deep with a radius of 42½ ft. was formed. No damage was done to the Austrians, but the crater was crowned, and next day a fresh gallery from it was put in hand. On the 4th of September a small countermine of 165 lbs. powder was fired, but had no effect except to make the Prussians more wary.

The happy idea now struck the Austrians of joining up the T-heads

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of their countermine galleries. This much improved the ventilation, and enabled them to work towards the flanks of the besiegers' mines without fear of their retreat being cut off. The Prussians now came across water, and had to abandon their gallery from the first crater and begin a second. On the 9th the Austrians damaged this with 150 lbs. powder with L.L.R. of 20 ft. and 30 ft. of tamping.

Next day the Prussians repaired their gallery, and when they had advanced about 80 ft., came across a branch of the defenders, who, however, contrived to explode a small mine, and destroyed about 65 ft. of the attackers' gallery. Thus 10 days after their first explosion, the attackers had to begin a third gallery from their crater. On the 16th the air in this gallery was so bad that it was decided to charge a second globe of compression of 2,200 lbs. of powder. 40 ft. of tamping was given, the crater was 16 ft. deep, and had a radius of 33 ft., but only one of the defenders' branches was damaged.

From their second crater the Prussians now commenced a new gallery, which was broken up by two camouflets each of 50 lbs. of powder. It was repaired, and another gallery parallel to it was started. These were both destroyed by camouflets on the 18th. Two new galleries met the same fate on the 19th and 20th.

Lefevre now almost lost heart, but Frederic ordered him to proceed again, and drive a gallery under the countermines for a large globe of compression, and a higher gallery to attack the countermines by camouflets. The higher gallery was discovered and damaged by a camouflet of 150 lbs. powder on 22nd, but was recommenced to distract attention from the lower and more important gallery. The latter was only 23 ft. long when countermining was heard on both sides of it. In spite of the short length available for tamping Frederic ordered a return to be excavated and 4,000 lbs. powder to be placed in it. This was successfully accomplished, and on 24th September the third globe of compression was fired, producing a crater 20 ft. deep with a radius of 33 ft. Some of the defenders' branches were damaged, and two of their miners killed, but neither the palisade nor covered way were touched. A great deal of the effect took place backwards, owing to the short length available for tamping.

Excavation was again put in hand, but by the 26th of September the defenders were threatening No. 3 Crater with five mines on the left, and one on the right. At midnight the firing of the latter gave the signal for a sortie, which was pressed with such vigour that the besiegers were driven back into No. 1 Crater, and to their third parallel. No. 2 Crater was crowned against them and all their works between that and the fort were destroyed. The defenders then retired from No. 2 Crater, and on 28th the besiegers began to drive a gallery from it under No. 3. A camouflet fired against this gallery left it unharmed, but a miner was suffocated by the fumes.

On the 8th of October when this gallery was 105 ft. long the Prussians observed a high column of smoke burst from the fort. A small magazine had been accidentally blown up. The only profit the Prussians drew from this mishap was time to charge their fourth globe of compression, which was 25 ft. deep, with 5,500 lbs. powder. The defenders then fired a small camouflet of 60 lbs. of powder which they had already prepared,

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but it was too high above the attackers' mine, and did no damage. A larger charge might have breached the palisade of the covered way. The fourth globe of compression was tamped for 52 ft. (twice the L.L.R.) and made a crater 39 ft. in diameter, threw down the salient, and completely demolished the countermine system. The ditch was so filled with débris as to allow of an assault being delivered. Next day the place capitulated.

What especially characterizes this siege is the open and direct advance of the mine attack on one line. The first globe was evidently fired at too great a distance from the fort. It would probably have been better, if, instead of a series of successive discharges, several globes had been prepared at short lateral intervals. There would not then have been the same risk of failure. However this may be, Belidor's globe of compression did not emerge from this test absolutely triumphant, and the reputation of countermines augmented to such an extent that, if the attackers knew that countermine galleries existed on any front, they preferred to confine their efforts to another front, and replace subterranean war by bombardment or blockade.

Besides the systematic establishment of permanent countermine galleries a characteristic of the third period of subterranean warfare is the close tactical connection between the miner and the artillery. Breaching batteries were of short range, and to be of any use at all had to be established as close as possible to the ditch. The certainty of having command over the subsoil was therefore of paramount importance. Neglect of this principle led to various disasters at Turin, while at Berg-op-Zoom the activity of the attackers' miner allowed the breaching batteries to be established in safety. The miner was therefore at this stage an indispensable auxiliary to the siege artillery.

A.R.R.

(*To be continued*).

THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1916.—(London: The Wireless Press, Strand, W.C. Price, 3s. 6d.).

The *Year-Book of Wireless Telegraphy and Telephony* is a volume which makes an equal appeal to the general and technical reader. It marks a distinct epoch in the advancement of the practical application of a new science that such a work should be called for, and should experience an ever-increasing demand for each succeeding annual issue. The present is the fourth occasion of its appearance, and the volume has been produced under all the disadvantageous conditions imposed by world-wide war.

Standard information, like the "Progress of Radio-Telegraphy," chronologically arranged, lists and particulars of ship and land stations, laws and regulations of the various countries in which radio-telegraphy is developed, etc., have all been—as far as possible—carefully revised and brought up to date. The text of the International Radio Convention of July, 1912, and the "Safety of Life at Sea" Convention of 1914 are both

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reprinted. An important addition has, however, been made to the summarized laws and regulations laid down in the various countries. This addition consists of a well-planned index immensely facilitating ready reference to the sections covered by it. The alphabetical list of call letters allotted to land and ship stations contributes similar valuable aid to ready reference for its own important division of the book.

The practical worker and experimenter have been even more adequately catered for than in former editions of the same work. The Dictionary (in five languages) and Glossary of Technical Terms is, this year, supplemented by a reprint of the Report of the Committee on Standardization which sets forth a list of definitions indicating the sense in which the various terms are employed upon the other side of the Atlantic. A large amount of useful data, selected in accordance with the unique wireless experience possessed by the Marconi Company, figure in the volume, and it is not insignificant of the unstinted care bestowed upon the matter here printed that the pages devoted to "Useful Formulæ and Equations" have been revised and brought up to date by Dr. J. Erskine Murray.

For the general reader, a large proportion of the interest is centred round the admirable series of essays upon those branches of wireless telegraphy which most arouse current interest. These vary in each edition of the Year-Book. The present volume contains a delightful comparison between past and present methods of naval war tactics as governed by means of communication. This essay which figures under the title of "Intelligence in Naval Warfare" has been specially contributed by Mr. Archibald Hurd, the well-known expert writer on such subjects. Colonel Maude supplies "The Allies' Strategy in 1915." Amongst these essays will be found a number of technical papers. Dr. J. A. Fleming discourses with all the charm of his accustomed lucidity upon the subject of "Photo-Electric Phenomena," whilst Dr. W. H. Eccles takes as his subject:—"Capacitance, Inductance and Wave Lengths of Antennæ," accompanying his text with an original series of abacs of extreme interest and utility. Two of the technical articles come from the United States, and deal—one with the "Progress of Radio-Telephony in the U.S.A. during 1915"—and the other with the "Measurement of Signal Intensity." The latter is from the pen of Mr. John L. Hogan, Junior, Vice-President of the Institute of Radio Engineers.

Many other articles which here find a place will appeal to quite a wide circle of readers. A *résumé* of some of the exploits of wireless, anecdotally narrated, appears under the title of "Wireless Waves in the World's War." The paper on "Problems of Interference" will prove highly informative to anyone with the most elementary idea of the general principles of radio-telegraphy. The possibilities and limitations of "jambing" besides other obstacles intentional and unintentional to the correct transmission and reading of messages find here a sober and authoritative elucidation.

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NOTICES OF MAGAZINES.

REVUE MILITAIRE SUISSE.

No. 4.—April, 1916.

THE TWO NEUTRALITIES.

The writer of the *Revue* article fears that an extraordinary and disquieting feeling of discredit attaches to the word "neutral." No one seems desirous to acknowledge himself a neutral, although perforce he is actually numbered amongst those to whom the appellation is applicable; even those who hold the status in respect will scarcely acknowledge as much. It is said that Belgium is prepared to disclose the whole of the facts relating to the circumstances under which she was compelled to renounce her neutrality; Greece vilifies her neutral state, and soon, both in Europe and on other continents, neutrals will be as difficult to find as the philosopher's stone.

There are countries which are neutral and must remain so without the remotest probability of a change being made in their attitude. Belligerents may not, it is said, be able to appreciate the necessity for the adoption of such an attitude, but the interests of Switzerland are so closely bound up with the maintenance on her part of the status of a neutral that her people can by no means regard with equanimity the prospect of any departure from her time-honoured policy. It is pointed out that the ancestors of the Swiss people did not, on the morrow of the Battle of Marignan,—early in the XVI. century—deliberately adopt a policy of neutrality without weighty reasons, a policy which succeeding generations continued to adhere to for the three long centuries preceding the period of the French Revolution and the Congress of Vienna. This neutrality was no doubt of a special brand, since the cantons individually were not forbidden thereby either to participate in warlike operations, or to deal directly with belligerent nations. To the form which this neutrality took is ascribed the fact that the Confederation continued to exist as a political institution and that it remained unaffected by the great European conflagrations which raged from the time of Francis I. to that of the great Corsican.

In view of the economic situation of Switzerland, her geographical position, her racial problems and her moral obligations, at no time has the wisdom of the progenitors of the Swiss nation in adopting a policy of neutrality stood out so conspicuously as at the present time. It is urged that four centuries ago the founders of the Swiss Republic sized up the situation with great penetration and, therefore, it is not for the present generation, however much they may wish to do so, to reverse the policy which has answered so well for many ages, particularly in view of the fact that the circumstances have not altered in the meantime.

The question of Swiss neutrality was on one occasion at least brought before the Swiss people in all its bearings. This was in connection with the Congress of Vienna. Swiss territory had very recently been violated, and a rearrangement of frontiers was in contemplation in

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Europe at that time. Switzerland formulated a demand to the Great Powers with regard to the territorial concessions she desired should be made to her in order to provide for the continuity of the existence of the Republic and the security of the Swiss frontiers. At that time, the Great Powers were inclined to regard Switzerland as being a vassal State under the domination of the great Napoleon, and they therefore expected something in the nature of compensation, and also guarantees for the purpose of safeguarding their future interests, in return for any territorial concessions which might be made. The Swiss plenipotentiaries therefore offered Europe an assurance, in legal form, of the policy of their country, that is to say, Switzerland undertook to maintain an attitude of "perpetual neutrality," under the guarantee of the Powers. The Great Powers considered this a suitable consideration for the purpose of binding the contract under the terms of which Switzerland was to remain for ever outside the influence of each and every one of the European states.

In 1831, on the initiative of Talleyrand, a similar artifice was adopted to bring about a pacific solution of the Belgian-Dutch conflict which threatened not only to undo the work of the Vienna Congress, but which also jeopardized the political equilibrium on the continent of Europe. Although the Swiss people had agreed with a good grace to the status of a neutral state offered to them, not so the Belgian nation, and consequently "perpetual neutrality" was imposed upon Belgium against the wishes of her people.

If the question be asked—"What is the difference between 'perpetual neutrality' and 'ordinary neutrality'?" The answer seems to be that, in theory, there is no difference since the legal definition is the same in both cases. However, in practice, a State which is under an obligation to regulate its relations with other States so as to conform to the requirements implied by the expression "perpetual neutrality" is bound so to act at all times as not to involve itself in a war. Further, it must so conduct its own affairs that in the event of other nations becoming involved in a war with one another, such a State must continue under an obligation to maintain its neutrality. It follows that a neutral state may enter neither into an Alliance nor into a Customs Union. Again, it has not a free hand even in relation to its own military affairs; for example, strictly speaking Belgium should not have put up a single fort within her territories without at the same time fortifying the whole of her frontiers on every side.

It may be urged that the above requirements are theoretical only and lack juridical sanction. There exist, however, in juridical treatises and in diplomatic correspondence clear expressions of opinion to counter any such suggestion. In Conventions relating to neutrality, the positive declarations of the Great Powers are confined to a statement that perpetual neutrality is, in such and such a case, guaranteed and it is, therefore, instructive to examine the value of such a declaration.

The doctrine on this subject is understood to mean that the Great Powers jointly and severally promise not only to respect the "perpetual neutrality" of the State to which the guarantee is given and to cause third parties to do the same, but they further undertake to compel this State to remain neutral towards all other States. It amounts to this: the Guaranteeing Powers enter into an obligation to keep a discreet but

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efficient watch on the conduct of the neutral State. This responsibility is by no means a theoretical one, as can be easily ascertained by reference to the history of either Switzerland or Belgium; for example, in 1889 Bismarck claimed, in the interests of Swiss neutrality, to establish control over the police in Switzerland; in 1842, Great Britain forbade Belgium to enter into a Customs Union, even of a limited nature, with France. Many other examples could be quoted of similar interference in the affairs of neutral States by one or other Guaranteeing Power.

The writer of the *Revue* article states that the guarantee of the Powers is really ineffective and does not completely safeguard a State against aggression. This is not only abundantly clear from the fate of Belgium in 1914, but its doubtful value has long been recognized by all publicists and statesmen who have given thought to the subject.

The writer of the *Revue* article is of opinion that so far as Belgium is concerned Great Britain, apart from Treaty obligations, was compelled to intervene to protect that country against the German invaders. He is of opinion that International Treaties in no way protect a neutral State, but only compromise its political liberty and, in a word, its sovereignty.

Swiss publicists have urged that their country enjoys a self-imposed neutrality which has been *recognized but not guaranteed*; and that the status of Switzerland differs from that of Belgium. But if it is not difficult to distinguish, from a legal point of view, the differences between the neutrality of Belgium and that of Switzerland, it is not so easy to ascertain how far the distinctions urged by jurists have been recognized by the Great Powers, and indeed, whether these distinctions involve a difference possessing practical importance. Opinions on the subject are all very well for use as arguments in diplomatic correspondence, but neutral States remain unfortunately at the mercy of powerful neighbours with regard to the extent that their neutrality will be respected. It was not Belgium, but Germany, that ultimately defined the limits of the former's neutrality.

The writer of the *Revue* article enquires whether the Swiss people still desire to live in the state of "perpetual neutrality" now so familiar to them. He states that it is not possible to enumerate the advantages of the "perpetual neutrality" under which his country has existed for so many centuries, for these advantages are not discernible; indeed, he considers that there is no superiority in "perpetual neutrality" as against a policy of *voluntary neutrality*. He continues, "neither is it possible to enumerate the inconveniences of 'perpetual neutrality'; such an enumeration would fill the pages of a considerable tome."

There seems to be a strong feeling that on the termination of the present war, there should be a *rapprochement* of neutral countries, a *rapprochement* having for its object the securing of the independence of these countries; but to the adoption of this course, there stands in the way one serious obstacle so far as Switzerland is concerned, namely, the international obligation under which she continues to maintain "perpetual neutrality." The writer of the *Revue* article urges that when the time comes to discuss peace terms the Swiss Government should endeavour to persuade the Great Powers to release the Republic from this obligation, an obligation which, at the present time, saps the liberty of the Swiss people.

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FIRE ACTION AGAINST AEROPLANES.

The *Revue* article deals with the factors which must be taken into consideration in directing fire against aeroplanes.

Since the graduations on the back-sight of a rifle or gun are intended for use against targets approximately on the same horizontal plane with the point from which such rifle or gun must be fired, these sights are of little value for aiming purposes in cases where the target is situated at some considerable altitude above the earth. Aeroplanes in flight are very difficult targets to hit; further, even when they are hit it is largely a matter of luck whether any serious damage is done to them or not. Some 6 to 8 per cent. of the surface of an aeroplane is alone vulnerable. The only sure method of putting an aeroplane out of action is by hitting the pilot, which is not an easy thing to do, since the walls and bottom of his seat are, as a rule, armoured with chrome-steel plates, 4 mm. thick, capable of resisting rifle bullets at ranges in excess of 600 to 700 yards, and shrapnel fragments at ranges in excess of 1,000 yards. To damage an aeroplane seriously it is necessary either to smash the propeller, or to pierce the petrol tank, or to put the motor out of gear, or to break an essential part of the motor, or to sever the stays, or to cut the connections of the rudder. A single projectile can by a lucky hit do sufficient damage in the cases just enumerated to bring an aeroplane to earth.

A machine gun mounted so as to be able rapidly to follow the movements of an aeroplane in flight is the most suitable weapon to use against these aerial machines; rifle-fire is of little value for such purposes. Under certain circumstances shrapnel fire may be usefully employed against aeroplanes.

Weapons for use against aircraft require to be equipped with special sights provided with automatic regulation. Two points call for consideration in this matter: the *range of the target* and *the angle of sight*.

From the point of view of taking aim at aeroplanes the *angle of sight* is as important a factor as the *range*, and varies exceedingly rapidly in the case of a fast moving target such as an aeroplane; for example, if in the case of an aeroplane flying directly towards an observer, let it be supposed that:—

α = angle of sight when aeroplane first sighted.
β = angle of sight one minute later.
h = the altitude in feet above the observer's position of the track of the aeroplane.
l = horizontal distance in feet traversed by the aeroplane in one minute.

Then
$$\tan \beta = \frac{h}{h \cot \alpha - l}.$$

So that in the case where $\alpha = 30°$, $h = 6{,}000$ ft. and $l = 5{,}280$ ft. β will be approximately equal to 60°; that is to say, during an interval of one minute the *angle of sight* will have increased to double its original value. During the same period the *range* of the target will decrease from about 4,000 yards to about 2,300 yards. The above calculations

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give some idea of the rate at which the *angle of sight* and the *range* of such a target as an aeroplane in flight vary.

So far as the projectile is concerned, the points for special consideration are those connected with the *influence of the altitude of the target* and the *action of the wind.*

In the case of a projectile fired at a target on the same horizontal plane as the weapon from which the projectile is fired, as is well known, not only the resistance of the air but the force of gravity both have a retarding effect on the velocity of the projectile during the period of flight along its parabolic path as far as the culminating point; after the point last mentioned is passed, although the resistance of the air continues to act as a retarding force, on the other hand gravity now acts as an accelerating force, and therefore tends to restore a part of the kinetic energy lost by the projectile whilst traversing the ascending part of its parabolic path. Where targets are situated in planes at certain altitudes above the earth the path of the projectile between the point of discharge of the projectile and the target ascends continuously and in such a case gravity does not act as an accelerating force until after the target is either hit or the projectile has passed beyond its mark. The writer of the *Revue* article points out that the variations in the velocities of the projectiles, though small, nevertheless have an influence on their range and allow highly mobile targets to keep out of danger zones with some ease.

In taking aim at targets at considerable altitudes above the earth, the refraction of the image forming light rays causes some inconvenience to gun layers and rifle shots; but the trouble experienced in this matter, it is said, has not been so great as some expected it would be. Another phenomenon to which attention has been drawn by those who have watched the evolutions of aeroplanes in flight is the invisibility of the machines, even on a very clear day, at altitudes varying from 6,000 to 7,500 ft.; under such circumstances, it is difficult to pick up aeroplanes with the best of field glasses, but once the machines are located they are easily followed.

In the case of projectiles fired at targets at a great altitude above the earth, a wind directly opposing or directly following the projectile has little effect in accelerating or retarding its flight; but on the other hand, a wind blowing across the path of a projectile causes a very considerable lateral deviation; this deviation, which naturally depends on the velocity of the wind, varies in inverse ratio to the mass and velocity of the projectile. Owing to the fact that in the case of fire aimed at elevated targets the projectile traverses various layers of the atmosphere in which the wind currents are blowing with varying force and in different directions it is very difficult, if not impossible, to make any correction for the wind in aiming at such targets.

The velocity of the wind and its direction naturally affect the resultant velocity at which an aeroplane progresses in a particular direction with any given number of revolutions per minute of its propeller. The drift and the resultant velocity produced by air currents under certain circumstances, in the case of an aeroplane travelling at a speed of 67 miles per hour (*i.e.*, 30 metres per sec.), is given in tabular form in the *Revue* and is reproduced here.

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Speed of Aeroplane, 30 Metres per Second.

Velocity of Wind. Metres per Sec.	Horizontal Angle between Direct Path of Aeroplane and Direction of Wind.									
	30°.		60°.		90°.		120°.		150°.	
	β.	V.	β.	V.	β.	V.	β.	V.	β.	V.
10	13·3°	22·0	19·2°	26·4	18·4°	31·6	13·9°	36·0	7·4°	39·0
20	38·3°	16·2	40·9°	26·4	33·7°	36·1	23·4°	43·5	12·0°	48·4
30	75°	15·5	60°	30·0	45°	42·0	30°	52·0	15·0°	57·9

β = Angle of drift. V = Resultant velocity in metres per second.

The fact that an aeroplane in flight is exceedingly mobile, and possesses great freedom with regard to the alteration of its course vertically as well as horizontally, renders it an extremely difficult target to hit. Aim should naturally be taken well in front of an aeroplane. The Swiss provisional regulations for rifle and machine-gun fire against aeroplanes (December, 1914) provide a rough-and-ready guide as to the distance in front of an aeroplane that aim should be taken; the following table gives approximate data for directing fire at aeroplanes in flight (assumed average length = 10 metres):—

Range of Target. Metres.	Machine Lengths in Front, that Aim should be taken.
300	1
500	2
700	5
1,000	7
1,200	9
1,500	12
2,000	17

A table (based on calculations) is published in the *Revue* showing the exact distances (in metres) in front of an aeroplane that aim should be taken at various ranges, from 500 to 2,500 metres; figures are given for a machine flying at speeds of 80, 100, 110, 120 and 150 kms. per hour. The approximate data given in the table above agrees very closely with the calculated data published in the *Revue* article in the cases of aeroplanes flying at a speed of 120 to 150 kms. per hour.

The *Revue* article also contains a table in which are set out particulars, including dimensions, of the different types of aeroplanes in use in the British, French and German naval and military services.

It is practically impossible to estimate by eye, with sufficient accuracy, the range of an aeroplane in flight; resort therefore must be had to rangefinders to obtain even approximate ranges. Owing to the great speed at which aeroplanes in flight travel rangefinders built on the "coincidence" system are alone of any use. Binoculars, in which one eye-piece is provided with a glass diaphram with graticules engraved thereon, form a very convenient and rapid means of obtaining the range of an aeroplane in flight. A very simple piece of apparatus for obtaining approximate ranges rapidly consists of a metal or cardboard sheet along one side of which notches or steps of various lengths are cut. The lengths of these notches or steps are calculated, by the well-known formula relating to similar triangles, and each notch or step is cut of such a length as to represent different apparent lengths of the target at some fixed distance from the eye, at some particular range.

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If the card is then held, at the distance from the eye for which the "apparent length" of the target was calculated, and adjusted so as to ascertain into which of the notches or steps the target exactly or most nearly fits, its approximate range will be at once apparent.—(*To be continued*).

SOME OF THE PRECEPTS OF THE WAR.

"Skill will beat mere brute strength."

Introduction.

"Woe to him who despairs."

The writer of the article points out that a terrible war is in progress on the very borders of Switzerland and that her people are standing to arms awaiting the final issue of the great struggle.

Dangerous doctrines are being preached which are having a most pernicious influence on the Swiss people; in consequence, some there are who have been lulled into a false sense of security, whilst others there are who have sunk into a state of despair. Yet at no time has it been more necessary than at the present for the public to be on their guard; on the one hand, against a too easily satisfied optimism, and, on the other hand, against a too exaggerated pessimism.

The optimists who now cry aloud: "Let us disarm! Let us demobilize!" are requested to take heed of Sven Hedin's words in *Un peuple en armes* where he says: "Woe to the people who have not set their houses in order in good time, but who have trusted to alliances and 'scraps of paper,' 'tis the Strong Arm which decides the destinies of nations, *Watchfulness* and *Force* alone inspire respect on every side."

The optimists are further asked to take note of an order published by the Headquarters of the 2nd (Swiss) Division in February, 1915, which states clearly enough that "the present war is far from being over," and in continuation draws attention to the probability that "the longer it lasts, the greater is the likelihood that the complications following in its train will increase."

"Take nothing on trust: be at all times on your guard" is the moral preached to optimists.

It is stated that the doctrines of the pessimists are, if anything, still more unhealthy than those of the optimists, since they cause in people's minds a distrust of themselves. These pessimists wish people to believe that victory accrues always to big battalions, to things material and to machines. Thus it is that they hastily run to the conclusion: "Switzerland is defeated even before she comes to grips."

The author is of opinion that it still remains to be proved that "Might is Right"; on the other hand, he claims that Skill will, to-day as in former times, always eventually defeat mere Brute Strength. The "Chiefs" of the Swiss Army are reminded that an all *imperious* obligation rests upon them to make a study of the experiences of the belligerents waging war on the borders of Switzerland, in order to draw all the profit they can from them for the benefit of the Swiss Army. They are recommended particularly to examine what those who have participated actively in the present war have to say regarding the part they and their brothers in arms have played on the battlefields of to-day.

Many of the ideas contained in the literature dealing with the present

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war are considered in the article to contain lessons of value for the Swiss Army, and he has extracted several of these ideas from the original publications and embodied them in his own article.

Experiences of the War.

The Paramount Importance of Fire Effect.—Fire effect has come by its own, so says Major d'André in his *Le Tir pour Vaincre.* And yet, at one time, faith was pinned exclusively in tactical evolutions as the deciding factor on the battlefield. The hecatombs for which fire effect was responsible at the beginning of the campaign of 1914 has caused the scales to fall from the eyes of those who were blind.

The writer of the *Revue* article points out that the experiences of the War bear out the principles contained in the Swiss "*Instruction de Tir.*" Major d'André states: "*Fire intended to kill* is in evidence very much to-day"; at the beginning of the War *fire effect intended to demoralize* the enemy loomed largest in view.

It is suggested that the French rifle fire has been decidedly inefficient and quotations are given from French and German documents to support this view; these quotations indicate that the French infantry have invariably fired at too great an elevation in the present war. History is but repeating itself, and the "Hochschuss" so frequently spoken of in relation to preceding wars occupies a very prominent place in the accounts of the present war. The musketry training of the French infantryman is said to have been at fault; steps have never been taken to convince him that it is necessary for him to become a good shot. On the contrary, it has been dinned into his ears that "in an engagement it is better that he should not take aim. Fire can thus be better distributed." And this in spite of the practical teachings of the Boer and the Russo-Japanese Wars.

In Austria, Germany and Italy, on the other hand, the correct principles of rifle fire were understood and applied in the training of the soldier. Happily, it was not necessary, it is said, for Switzerland to await the experiences of the present war, in order to put musketry training on to right lines.

The War of Evolutions.

In a vein of sarcasm Major d'André writes: "Everyone wishes to manœuvre, no one wishes to fight." He further points out that the training of the French infantry was based on the requirements of a war in which the manœuvring of troops was expected to play the most prominent *rôle.*

That the French General Staff misjudged the requirements in relation to the coming war now upon them is evident to everyone who makes but a very cursory examination of the progress of the War; the war of manœuvre gave way to trench warfare within a few weeks of the opening battles of 1914.

The following extracts reproduced from the French and Swiss Regulations show how widely the views on the subject differed in France and Switzerland.

Swiss Regulations: "The object of a fight is the destruction of the enemy. Fire effect is the chief consideration on the battlefield; manœuvre, since it enables the distance separating a body of troops from the enemy to be diminished, is the means of rendering fire effect more telling."

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French Regulations: "Fire action has one object alone: that of facilitating evolutions."

It is suggested that in France the "tactics of instilling fear" were preferred to the "tactics of killing"; both at manœuvres and in the solution of "Kriegspiel" schemes too little attention was paid to the man, his weapons and the terrain. General Cherfils sums up the situation in the sentence: "Too many skirmishers, not enough sharpshooters."

In the *Echo de Paris* of 4th February, 1915, it is pointed out that modern war has brought about a profound modification in the ancient formula for obtaining victory. Formerly, in order to conquer, it was sufficient *if the soldier was not afraid of being killed.* With the modern arms of precision fire is so accurate that *the soldier, if he can, ought to be afraid of being killed.* It is no longer a case of allowing one's self to be killed, but of killing one's enemy.

The French paid, it is said, a big price for the experience gained during the early days of the present War.

The Offensive or the Defensive?

Much is said at the present time of "the bankruptcy of the offensive." Whether the offensive or the defensive is the superior of the two is a question not yet fully ripe for decision.

If, at the beginning of the War, the success which crowned the application of the doctrine of the offensive was dazzling, not less remarkable were the checks which later went to destroy faith in the infallibility of the principles that have been so universally accepted. What is certain is that both in the case where success has been obtained as where failure has been the result, as a consequence of the adoption of offensive warfare, the armies of Germany as well as of France have suffered serious losses. There are obstacles which no offensive can break through; of this fact the War provides many examples. A proper utilization of the terrain and field fortifications have conferred on the defensive a power which was quite unsuspected. The lesson which stands out most prominently is that now more than ever is it necessary to teach the soldier *to make the best use of his firearms and the tools of the pioneer.* It is recommended that whilst the spirit of the pure offensive should still be inculcated in troops, yet it is as well to familiarize them with the principles of the stubborn defensive which may have to be resorted to. These principles are summed up as follows:—

(*a*). A good rifle-shot must never permit the enemy to get within easy reach of the position he is holding nor must he allow the enemy to turn him out of it.

(*b*). All positions are impregnable when defended by soldiers worthy of the name.

It has been said that the defensive power of Switzerland is so great that she can hold at bay an enemy possessing fourfold the numerical strength of the army she can put into the field. The Swiss are recommended to take note of this, since it is a reassuring statement.

Everything for the Guns: Nothing for Others.

Major d'André states: "Artillery comes in for all the drudgery, and infantry only advances when the former announces that the repast is ready." The opinion now prevails very widely that only the guns, big and small, and machine guns are alone doing real work in the present

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war. The infantry, some think, has now only the final task left to it of clearing the enemy out by a bayonet attack; to it has been assigned the honour of being a target for the enemy's fire. False impressions are likely to be created by the dissemination of views similar to the foregoing. The attempt to draw distinctions with regard to the utility of the different arms of the Service is futile; on the modern battlefield the solidarity of the various arms is complete; the most intimate and absolute co-operation, on the part of the troops of every branch, is the chief consideration making for success.

The Bayonet.

In his *Le Tir pour Vaincre* Major d'André has pointed out that: "It is the bayonet that is fixed to the rifle . . . and not the rifle to the bayonet." The view that bayonet fighting has first place and musketry second savours much of the ideas of very old times.

The *Revue Militaire Suisse* in its number for March, 1913, sounded a note of warning in relation to the marked tendency shown in France to make the bayonet the principal weapon of the infantryman. An extract from the article is reproduced, its concluding sentence is as follows: "All these instructions regulating bayonet exercises are eye-wash at most, 'tis not thus that armies can be prepared for war."

At the beginning of the War the French infantry made some brilliant bayonet charges, but only to suffer cruel losses for no purpose. Now, grenade attacks have taken the place of bayonet charges to a large extent. It must not be supposed that the experience of the present war teaches that the *arme blanche* of the infantry, the bayonet, is of no use in modern war; far is this from being the case. The bayonet is still useful for fighting at night, in fogs, in woods, etc. Bayonet exercises are still a valuable form of gymnastic training.

Quantity or Quality?

An oft-quoted phrase has it that "Providence takes the side of the big battalions." The predominant influence of masses and materials in a modern war is now universally admitted. The cry is for more big guns, for more big battalions. If, however, in war it was a mere question of numbers deciding, and nothing more, then the small Powers would be wise if they at once ordered their troops to pile arms, fold their arms and to accept with resignation the cruel fate of becoming the subjects of a State no longer free but the vassal of a hostile power.

The writer of the *Revue* article energetically repudiates the correctness of the foregoing assumption. "The dogma is false," he says. "Appearances are deceptive, nothing must be taken for granted." The factor which dominates the situation is after all *the man*.

In his *Études sur le Combat* Ardant du Picq has stated: "The theory of big battalions is a shameful theory. Both the most obscure and the best known orators, who to-day talk of things military, speak only of masses. The man has ceased to be visible in these masses. Numbers alone are visible; quality is quite lost sight of, and yet, to-day as of yore, quality is alone worth considering, indeed, the real source of all action."

In the *Journal de Genève* of the 26th January, 1916, Colonel Feyler, in an article entitled: "The German Doctrine in Relation to Strategy and the German General Staff," states that quality is a more important factor than quantity, and points out that this is, in brief, the view also

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of Bernhardi. Those who will take the trouble to search the pages of history will find therein convincing records to satisfy them that from the time that little David slew the giant Goliath right up to the present time, Quality has times out of number obtained a brilliant triumph over Quantity.

The Masses.

In accounts of the fighting which has taken place in the present war mention is frequently made of attacks in mass formation, and in deep columns. In an article which appeared in the *Revue Militaire Suisse* for August, 1915 (*vide R.E. Journal* for December, 1915, p. 307), it was explicitly denied that the Germans had employed mass formations for the attack and an attempt was made to explain away the newspaper references to attacks in deep formation. Nevertheless, the belief prevails very widely that the German troops have been in the habit of advancing to the attack in mass formations. In the earlier battles a large proportion of the highly trained soldiers of the German Active Army was wiped out and had to be replaced by less highly trained men ; and it may well be that deep-column formations were resorted to by the German Commanders to give confidence to the latter. Ardant du Picq points out in his *Études sur le Combat* that " when generals conclude that they can no longer get young soldiers to push attacks home in normal tactical formations, they attempt to do so in mass formation, which is a return to the infancy of the art, a kind of makeshift prompted by despair."

Major d'André makes, in reference to the same subject, the laconic remark : " Can it be that the enemy had so little respect for the marksmanship of our infantry that he dared to assault the positions held by our ' poilus ' in such vulnerable formations ? "

Naturally, an advance in any formation would succeed against troops that shoot badly. On the other hand, a few marksmen and a few machine guns, in the hands of well-trained and collected men, would mean the immediate destruction of troops in mass formation, a victory complete in every respect of Quality over Quantity !—(*To be continued*).

NOTES AND NEWS.

Switzerland.—A correspondent contributing an article to this number of the *Revue* makes a passing reference to the scandal with which the names of Colonels Egli and De Wattenwyl are associated, and states that, however regrettable it may be, yet the fact remains that the sympathies of the Swiss people and army are widely divided in relation to the Great War. The majority of the French Swiss profoundly wish that the Western Allies will be victorious in the campaign now in progress ; a large proportion of the German Swiss, on the other hand, are praying for success to the arms of the Central Powers. Under these circumstances, the Federal Authorities are finding it difficult to maintain an attitude of absolute neutrality.

Dealing with another matter, the correspondent states that the Swiss military tribunals are greatly in disfavour just now, particularly with the French Swiss. He suggests that the law governing these institutions is out of date and urges that the Federal Authorities should, without delay, put matters in relation to military tribunals on a satisfactory footing by passing an amending act.

A matter of greater delicacy with which he deals relates to bombs which the dear " Kameraden " of the German Army dropped on Porren-

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truy; he hopes that this is the last bombardment that Swiss territory will suffer at the hands of German aviators. The incident appears to have led to severe criticisms, on the part of the Press, on the conduct of the military authorities. Fortunately, the temper of the Swiss Army remains unruffled by these newspaper attacks upon it, and the greatest harmony, it is said, prevails between the officers of French and German descent.

Among matters of particular interest at the moment is the fact that the Government has re-established the Central Schools of Instruction for Officers which were suppressed in 1914 and 1915.

Another matter which has created some interest is the census which has been prepared in Switzerland of all men, between 16 and 60 years of age, not liable to military service, who either possess a rifle or know how to use one

France.—A special correspondent calls attention to the fact that the Portfolio of the Ministry of War has been transferred once more; this time into the hands of General Roques, who is the fourth Minister of War France has had since the War began. Roques, who succeeds General Gallieni, had a command in the Woevre; his military career has been a brilliant one, but he is new to political life. High praise is given to General Gallieni for the measures adopted by him during the early days of the War; it is to these measures that France owes her escape from the desperate position she found herself in when the Germans were closing on Paris. General Gallieni's predecessor, Millerand, was unpopular in Parliament, owing to the fact that he put great powers into the hands of the military authorities.

General Gallieni has come in for a good deal of criticism in connection with his tenure of office as War Minister. He has been accused, *inter alia*, of persistent jealousy and of thwarting the French generalissimo, his *soi-disant* rival. He is a man of wide experience, and seized the opportunity which presented itself of introducing far-reaching reforms into the French Army; he has, in the opinion of the writer of the *Revue* article, played his part with skill, energy and promptitude, and has not hesitated to remove high-placed officers who have proved themselves incompetent.

This number of the *Revue* concludes with a short bibliography.

W. A. J. O'MEARA.

RIVISTA DI ARTIGLIERIA E GENIO.

January—March, 1916.

OBSERVATIONS ON THE STUDY OF HEAVY CUPOLAS.

By Colonel Marullier, of the Engineers.—"The Captain of Engineers, Sig. Tomaso Volpe, in an article written for the May number of this *Rivista*, refers to an inexactness of calculation in a note at the foot of a page in my *Studio di Cupola Pesante* relative to the penetration of projectiles, drawing thence an argument sustaining that the principle on which my above-mentioned study is based does not fulfil all the advantages which at the first view they would seem to possess. Although an assertion

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of this kind may be interpreted as a condemnation of the proposed system I am unable to exempt it from confutation."

In substance the author of the article says: Since the part of the force of the projectiles absorbed by the cupola owing to the combined movement is small, very little usefulness can be drawn from the said movement on which our study is founded.

The advantages attributed to the proposed system do not follow from the circumstance that the movement of the cupola transforms in part into mechanical work the energy of the projectile, but essentially from the indisputable fact that whatever may be the mass or the violence of the shock owing to the direct action of the projectile, this may be circumscribed between certain well-defined limits, the force and the conflicting resistance thus rendering the strife or action between the projectile and the cupola always sustainable.

There are two phases to be considered. In the first, the action of a projectile striking the cupola only produces a diminished restraint in the latter, and during this movement the machinery devised to sustain the cupola and which causes it to rotate, together with its guns, would not work if not subject to the simple compression resulting from the contrast between the reaction of the restraint and the force equal and contrary which causes the descent of the cupola. In the second phase, since the portions of the machinery cease to be disturbed by the force of the shock they would evidently remain uninfluenced by causes intended to change their normal state. So now there being no external action which has an exclusive effect on the armour it is clear that by assigning to the parts indicated a sufficient thickness it will always be possible to realize the protection required.

France.

French Anti-Ærial Gun.—A German review makes mention of the following notice of an anti-ærial gun adopted in France:—The anti-ærial automobile gun has a calibre of 7·5 cm.; it is mounted on a platform, which during the fire is supported on the ground. In other automobile guns of a different pattern the supports or jacks applied to the platform are four, and liberate the wheels of the autocar from the strain caused by the fire. France also possesses a special cannon with a calibre of 10 cm. and a projectile weighing 10 kg. and having an initial velocity of 613 m. The machinery and the supports for this gun are similar to that of the cannon of 7·5 cm. Its total weight including the protecting shields is about 2½ tons.

New Dirigibles.—The same review observes that in France while so much attention was devoted to aviation previous to the outbreak of the war there was a decided diminution of interest in the construction of dirigibles, and that the result has been unfavourable. The number of dirigibles was limited, and their practical use was disputed. It was only when the political situation became strained that attention was seriously given to the creation of an ærial fleet.

A little before the war orders were given to the three well-known c nstructors, Lebaudy, Clèment-Bayard, and Astra Torres for a few dirigibles; one with a semi-rigid system was from the firm Lebaudy with nine motors of a total force of 1,350 h.p. and two other non-rigid airships

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were ordered from the firm Clèment-Bayard. These had a length of 130 m. with a car 50 m. in length; four motors each of 250 h.p. and four screws; for initial ascension a subsidiary screw with a suitable motor was provided. For the new airships a velocity of 75 km. with a useful portage of 11 tons. A third system was placed with the firm Astra Torres of similar dimensions and h.p. to that of the Clèment-Bayard.

The German periodical alleges that although a year has passed nothing is yet known regarding the complete preparation of this new ærial fleet.

Mechanical Excavation of Trenches.—According to quotations from the periodical cited France has under consideration the employment of mechanical means in actual warfare for the excavation of trenches. The operation would take place by means of a plough and motor. The invention is suitable for loose soil which can be thrown on one side forming a parapet at once utilizable. The power of the apparatus is remarkable. The heavy ploughshare working at very great velocity (about 1,000 revolutions per minute) and is such that it may be found useful even in the excavation of ground of great compactness.

GERMANY.

Special Projectiles against Airships.—From the review *Le Génie Civil* of the 29th January the following notices are extracted on some types of projectiles adopted in the German Army against airships:—

The common characteristic is the breaking up of the projectile in the act of explosion in a manner that the falling fragments are not a source of danger to the friendly troops.

One type of projectile constructed at the Rheinische Metallwaren-und Maschinenfabrik of Düsseldorf is a shrapnel which does not differ from ordinary shrapnels except in its construction. This made like a shell which explodes either by percussion, or by a time fuze to the match of which is given ignition at the same moment as the match of the principal fuze of the shrapnel. The small bullets are projected along a cone with an aperture from 12° to 14° and the fragments of the shell along an angle of 200° in all directions at distances varying from 200 m. to 300 m. The projectile will then be effective over a space of 700 m. in depth by 300 m. in width. The shell in addition to the explosive charge contains an incendiary mixture which also produces at the moment of explosion a cloud of smoke which assists the observers of the fire. Another type only differs from the preceding one because the projectile contains an incendiary charge in place of the bullets.

Another type constructed at Krupp's manufactories is devised on other ideas. In front of the projectile there is a metal plate for percussion with a spiral spring. To the metal plate are attached two small points tipped with flint. When the projectile strikes the envelope of a dirigible the spring on the percussion plate becomes compressed and sparks are produced from the flint and steel arrangement which ignites the hydrogen of the balloon. The same phenomenon is repeated when the projectile passes through the envelope on its exit.

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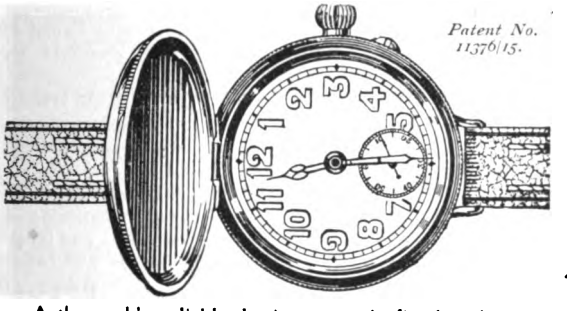

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Order of Battle of German Armies in Western Theatre of Operations—Some of the Precepts of the War—A Few Notes on Musketry Instruction. By Major W. A. J. O'Meara, C.M.G., *p.s.c.*, late R.E. (Barrister-at-Law of the Inner Temple) 86

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*LORD K.**

By VISCOUNT ESHER, G.C.B.

THE soul of a people resembles that of the supreme artist. Holbein and Gainsborough set before themselves a man's character, and perhaps exaggerate its peculiarities, although with extraordinary insight. The most famous portraits of statesmen and heroes delineate characteristics which the people have long since visualized after their own instinctive fashion. There is no divergence between the conclusions of the artist and those of the man in the street. What a great painter saw in the face of Scott, his contemporaries had already seen, and it is written in the book of the living for all time.

Long before the Northern seas engulfed him, his countrymen had declared their judgment about Lord K. In strength and integrity he had stood for twenty years upon a rock of popular confidence, among the shifting sands of parochial politics, and amid the threatening storms of international conflict. In him the Empire knew that it possessed a reserve force against the day of emergency or distress; and when that day dawned in unpreparedness and indecision, he vindicated the people's reliance upon his energy, and fulfilled their belief in his spirit of counsel and might. Detraction cannot harm him now, or envy obliterate his fame. For all time Lord K. is enshrined as the legendary figure of the Great War.

He shall be judged by what he was, and also by what he was not. Born in Ireland, but of English descent, his life had been lived in the wilderness and solitary places. The Orient had passed into his blood. The "call of the East," and its loneliness, fashion the devices of men's hearts; and they profoundly influenced his habits of thought and methods of action. His colleagues in the Government were astonished at both, and they often baffled his subordinates in the Army. To the politician and the bureaucrat he held a language they understood not. The Arabs had taught him to read the thoughts of others with weird facility, and in the desert he had learnt to conceal his own. Plain men were estranged by what seemed to them obnoxious tricks, and they charged him with deceit, when, with lack of insight, they found him inscrutable.

The aloofness of the desert places in which his youth had been spent was round about him in the Council Chamber. He refused to lay bare his inmost thoughts; and he sought to command, when he

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was expected to discuss. In argument he was a child before the thrusts of the keenly fashioned weapons wielded by his colleagues.

He would return from a long Cabinet, drop into a chair at York House, so weary and undone that further labour seemed impossible. Yet he would be found at the War Office after a short interval, grappling with the work he did so well, which a convention had interrupted. Once he complained to M. Briand of his inability to walk in the ways of politicians, his failure to provide them with plausible figures, or a well-adapted formula, and his lack of the art of parliamentary fence. M. Briand said to him, "You are the resultant of your upbringing, and your life environment. You have lived in lands where you could order a village to be pulled down here, or built up there, and where your word was law. But these methods are unadaptable to the Boulevard des Italiens."

Lord K. was conscious of his Orientalism, and many is the time that in intimate talk, posing as a dweller in a strange land, he has humorously taunted me with the habits of *my* country, and the idiosyncrasies of *my* countrymen. A statesman, an organizer, and an administrator he surely was, but he was not primarily a soldier. He negatived with clarity and decision the notion that he had trained his mind to statecraft by the study of history; or to war by the writings of Clausewitz.

At the Battle of the Atbara, a Staff Officer rode up to him, and on behalf of Sir Archibald Hunter asked for some tactical instructions. "Go back and tell him," said Lord K., "that it has taken me three years to bring him here to fight this battle, and that the issue is now in his hands, and not in mine."

An illustrious Frenchman said of Napoleon, "Il fut moins soldat que grand commerçant," and the phrase—questionable in reference to that myriad-minded portent—applies with signal fidelity to Lord K. Described as a mighty disorganizer by his critics, he possessed in reality all the highest attributes of a constructive administrator; a clear sense of objective, undivergent resolve, flexible methods, and patience. His views were long views, but in action he was quick; and wasting no time himself, he could not tolerate its waste by others. He was said to be ruthless in discarding broken implements, but I found him almost unduly sensitive to giving pain, even to those who served him badly, provided they did so to the best of their powers; and if one could accuse so strong a man of weakness, I should have called him feebly disinclined to lighten his own labours, when the achievement entailed hurting the feelings of others. For carelessness or neglect of duty he had no pity, but for incompetence he showed extraordinary compassion and unfailing good temper.

During the heavy flanking attacks delivered, not without justice, in view of a grave national danger, by the Northcliffe Press in 1915

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upon his administration, Lord K. would make no scapegoat, and firmly refused to share blame, for which he took all the responsibility, with any of his subordinates. In public he covered every one with his authority, and in private he reproached no one but himself. These qualities bred confidence in those who served him, and inspired devotion in his friends and associates.

It has been said that he possessed few friends, but this is a travesty of the truth. If to be a companion of men, or a philanderer after women, is the superficial test of friendship and popularity, he enjoyed neither ; but if quiet intercourse, right of access at all times, absence of reserve, shy but warm greeting, and an affectionate assumption of the right of service, are significant of true friendship, then Lord K. had intimate and faithful friends both among men and women. That he could inspire devotion in a heart fortified by knowledge and faith was exemplified in the " Fitz," whom he loved and trusted, whom we also trusted and loved, and from whom he was never parted, not even in death.

Lord K.'s towering personality and forceful character were apt to sweep men off their feet, but in later years, when age began to tell, his impressiveness varied according to his bodily vigour. When rested and unharassed, he seemed to the casual stranger to have in him the spirit of the holy gods. Often it was otherwise. Recently I had occasion, in the early morning, to hear him unfold his views on the political strategy of the war, as its prospects appeared to him. He was unwearied and fresh, and his mind played over the vast area of the war with a clearness of vision and a logical sequence that would have astonished those who had seen him in less incisive moods. I saw him again that same day, after a prolonged Cabinet sitting, and the virtue had gone out of him. He was as garrulous and inconsequent as any Front Bench politician.

There was an occasion many years ago when this variability affected his destiny. The Viceroyalty of India was under consideration. For administrative reasons that appealed strongly to the Secretary of State for India, objection was taken to the nomination of a soldier. King Edward had been anxious for the appointment of Lord K., and the recollection of our dead sovereign's wish carried great weight. The Secretary of State had never met Lord K. Circumstances had occurred that seemed to indicate to me as the means of bringing about a meeting. A dinner was arranged in a private room at the Savoy. Lord K. had that morning confided to me his keen desire to return to India as Viceroy, and his determination only to serve his country when he knew he could do so with all his powers, and could profit by his very special experience. India, Constantinople, and Cairo were designated by him as potential fields of action, but he expressed a strong preference for the Government of India.

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That morning he was at his best, and would have converted Athanasius. Later that same day he was at his worst, in his anxiety to make a favourable impression. A curious shyness took the form of rash speech, that became his undoing. In a quarter of an hour he had disposed of any faint chance he may have had of overcoming a determination, based upon principles of life and government, that in the Secretary of State for India proved then, and notably since, to be inflexible.

If prophets go forth from the solitudes of the hills and of the desert, then it may have happened that gazing for so many years over the wide expanses of Egypt had given Lord K. a broader area of vision than is commonly found in street-bred statesmen ; but it certainly did happen that in those fateful days of August, 1914, he alone saw the duration and character of the war.

I remember well an occasion when a number of French officers introduced by General A. Huguet, one to whom England and especially France owe a debt of gratitude impossible to acquit, had just left him. They and the British General Staff were about to proceed oversea with the Expeditionary Force, and all were in high spirits. I happened to meet them outside Lord K.'s room, to which I had been summoned. They bade me farewell, but only for three or at the longest for six months. A few minutes later Lord K. was telling me what I have mentioned elsewhere, that he, on the other hand, took a very different view and was preparing for a long war, of not less than three year's duration.

"These French officers," he then added, "are convinced that the German main attack will come through the *trouée* where the French armies are massed and where they are well prepared. I do not agree with them, and have told them so. It appears to me almost certain that the enemy's advance through Belgium will prove to be their main attack."

This was the first occasion upon which Lord K. thought it necessary, in consequence of service he claimed from me, to speak plainly his views upon the progress and prospects of the war. It was followed by many others. His opinions, reflections, and forecasts, up to the final parting before I came to France a month ago, were carefully recorded. He dealt freely and openly with every phase of the political and strategical problem, on the Western and Eastern Fronts, and it will surprise those who have questioned his capacity and doubted his judgment to read some day the story of his prescience. When he changed his views he was the first to make the admission. His words, hampered by inexperience and shyness in the presence of critics, came easily and tersely to the rescue of his thoughts in private intercourse.

That Lord K. was at his worst in counsel may be readily conceded. Had, however, our institutions permitted the sole responsibility for

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the conduct of the war to be placed upon his shoulders, had he been compelled to deal alone with the diplomatic Balkan problems, as he dealt with Fashoda, had the organizing of victory been left absolutely in his hands in this great war, as it was in the Soudan and South Africa—the face of Europe would have presented a very different aspect to-day. At such critical dates as January of last year, 1915, he would—if acting alone—have taken decisions that would have changed the fortunes of the war, and led far sooner to its close. His imperious temperament induced him to prefer his own plans to those of others. I had occasion to make many suggestions to him, and I never recollect his adopting any one of them.

Especially interested in the Territorial Force, I urged him to build upon that foundation his new armies. A questionable vanity leads me to the conclusion, even to-day, that he might well have done so. I am certain that a more commonplace Secretary of State would have yielded to the reasons that were urged at the time. It was the sound official view, and under sound official administration we might have raised a million men by such unexceptionable machinery. Lord K. had vaster designs, and felt that to give effect to them he required the stimulus of new methods, and a fresh machine. He employed both, with stupendous results visible in the great Imperial Armies now assembled in France and elsewhere. It was not the first, but the last million of British soldiers he could raise that were ever present in his mind.

In 1911, many secret documents were composed, and many military publicists took pains to prove, beyond all reasonable doubt, that in a war between France and Germany the decisive battles would be fought within the first fortnight of the outbreak of hostilities, and that the presence of our six Divisions in the field at the crucial point, and at the earliest possible moment, was the essential element of success.

In the autumn of that year, Lord K. scouted this notion as puerile, and wrote to me, what he repeated with emphasis in 1914, that the war would be ended and victory achieved by the "last million" of men that Great Britain could throw into the scale. This was his solvent for the desperate problem with which Europe was faced. Until he saw his objective within reach, and the armies of which he dreamed materializing all over the Empire, his days were harassed and his nights sleepless. No man felt so persistently and so acutely the high pressure of the war as Lord K. In his house at Broome and in the long evenings at York House, this preoccupation never left him, although he tried to divert his thoughts into other channels. Invariably he returned to the one engrossing topic of how to defeat our enemies in the shortest possible time. The faithful Fitz—indeed everyone admitted to his intimacy—tried to give his strenuous mind some relaxation. It was a fruitless task, and as the cold Northern

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waters closed over him, I am certain that his last prayer to Almighty God was for the Armies he loved, and the victory he had so ardently desired.

At a gathering of the Allies, among the French statesmen and soldiers at the Grand Quartier Général, among his colleagues at a war council or in any sort of company, Lord K.'s personality was dominant. Stature, both of body and soul, was his main characteristic. Politicians and some soldiers said of him, this man is not "clever"; he is unimpressive in his judgments; and mightily inarticulate in momentous discussion. Nevertheless, he stood a cubit higher in the eyes of the people than any of his contemporaries. *Securus judicat orbis terrarum.* There we may leave him.

He had much prejudice to contend against on the part of many who, although they feared him, resented his strong personality, and his ignorance of English political methods. He showed no resentment, and bore no malice. Much contemptuous and unjust criticism of his acts and ways came to his ears. Attempts were frequently made to exasperate him against his critics with a view to injure them and their professional or political prospects. These attempts invariably failed. But he felt deeply the want of loyalty, and above all the lack of friendly regard on the part of those with whom he laboured and associated.

I can see him standing with bowed head, with his back to the fire, in his bedroom at the British Embassy in Paris. In three hours he was to leave for Egypt and Gallipoli. His return to England, he had said a very few moments before, was very problematic.

The task of having to evacuate Gallipoli he dreaded and disliked with all the intensity of a nature accustomed to vanquish obstacles and to achieve success. He could, he said, perceive no ray of light. He spoke of those who had seen him leave England without regret, and very solemnly he added words that if quoted could only give rise to feelings of remorse in those of whom he spoke gently and regretfully. When he raised his head his eyes were full of tears. Fitz and I, who were present, were struck speechless. Here in France Lord K.'s great qualities were valued, and his value recognized. In the eyes of the French Armies and the French nation, he stood for England. His death and the manner of it have vibrated through this land. It is known here and appreciated, that on the very day when the fatal news was received, another Division of the Armies that bore his name had begun to land on the soil of France.

"He was a fine character, lovable, and straight—really," is the simple phrase in which a great soldier sums up the leader under whom he had served. No other epitaph is required for the man. As for his achievement, many waters cannot quench it, nor can the floods drown his fame.

ESHER.

France, 1916.

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*EARL KITCHENER OF KHARTOUM.**

By CHARLES WHIBLEY.

IT is the paradox of Lord Kitchener's career that, though he had spent but a few brief years in England, he was better known from one end of Great Britain to the other than any other Englishman of his time. He possessed in a high measure the true qualities of an Englishman. He was curt in speech and firm in action. He went about his business always with a clear perception of the end at which he aimed. It was his habit to dominate events, not to wait blindly upon hazard. When he made his famous advance upon Khartoum, for instance, he had planned every detail of march and victory before he set out upon the road. He understood perfectly that battles are not won by will or by accident, that troops must first be trained and railways laid; and he proved how much British zeal and British foresight might accomplish in a country where our armies had too often been left to be the mere sport of chance.

It was, then, the qualities of the gravely practical man that endeared Lord Kitchener to the English people, which saw in him precisely the virtues which it would, if it could, always possess itself. And there is another reason why Lord Kitchener should have won the sympathy of every unit in the unimpassioned democracy. He was one who took up more space than his fellows. He had that rare faculty of displacement, which only the great ones of the earth may boast. He could not escape notice as he passed from York House to the War Office. His presence in a room was instantly felt. He had not the tricks nor the graces of the orator, and yet the plainest statement which he read, sometimes painfully, in the House of Lords, carried with it all the weight which belongs to sincerity of mind and simplicity of purpose. Indeed, the mere fact that he spoke not as a politician but as a soldier vastly enhanced his fame, and we may find a certain consolation in the trust which the people reposed in him. After all, the great prize of life, the confidence of millions of men, is not given only to the professors of a showy rhetoric.

In one other respect Lord Kitchener showed himself an Englishman of the true breed. He depended less upon balanced judgment than upon quick instinct. To discover the course which he ought to follow was with him a process of feeling, not of thought. Where a

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smaller man would find you a hundred reasons why he should do this or should not do that, Lord Kitchener went straight to the point, as though he had omitted all the steps which generally separate a design from its fulfilment. And he added to this instinct of action a wide grasp of detail. When he had made up his mind, he could not always explain why he had made it up in that particular direction. But he saw instantly all the means which were necessary to fulfil his purpose, and he neglected none of them. In other words, he was swift in resolution, deliberate in action, and upon this happy combination of qualities the success of his career was built.

That he should have won the confidence and affection of all classes, that his death was mourned with a grief which few among the sons of men inspire, were the just reward of a life given wholly to the public service. Ever since he received his commission, in 1871, Kitchener had devoted himself with a whole heart to the welfare of England. The first years of his activity were spent in surveys of Palestine and Cyprus—of great value in themselves and of importance to Kitchener, because they laid the foundation of that familiarity with the East and with Eastern modes of thought which afterwards stood him in good stead. From the year 1882 onwards he played his part gallantly in the drama of Egypt, and began the fight with Mahdism which was finished only at the taking of Khartoum. He crossed swords more than once with Osman Digna; and in 1892, ten years after he had entered the service of the Khedive, he succeeded Sir Francis Grenfell as Sirdar.

In 1896 Kitchener undertook that which perhaps remains his greatest achievement—the conquest of the Sudan. His victories at Dongola, Atbara, and Khartoum have passed into the proud inheritance of our race. And these victories were won not by a series of brilliant dashes into the desert, but by months of sedulous toil and perfect organization. Here for the first time Kitchener proved his mastery of all the details which further the progress of a campaign. And whatever was done was done by the man himself. He had trained his soldiers, he had arranged his commissariat, he had seen the railway justly and truly laid. The advance upon Omdurman was a triumph of military skill and courage, and the battle which preceded its fall avenged the death of Gordon and made us masters of the Sudan. Nor did Kitchener fail his country when at Fashoda he was confronted by Colonel Marchand and his expedition. He turned lightly from warfare to diplomacy, and by his tact converted what might have been a delicate situation to the advantage of England.

The rewards which his gallantry and prudence had earned and deserved were lavished upon him. He was raised to the peerage, and received with a grant the thanks of Parliament. Better still, he was given an instant opportunity to justify anew the confidence

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of the country. When Lord Roberts was sent to South Africa, Kitchener accompanied him as Chief of Staff, and served his Commander-in-Chief with a loyalty and self-suppression which are not always found in one who for years had enjoyed an independent command. Upon Kitchener fell the heavy duty of suppressing the guerilla warfare of the Boers. He pursued his adversaries relentlessly; he swept the country from end to end with military vigilance; he invented the system of blockhouses which at last ensured the victory of the British arms; and he showed his wisdom and clemency when the right moment came by offering terms which were by no means dishonouring to a valiant foe.

Again his sojourn at home was cut short. Scarcely had he set foot in England after the Boer War than he was sent to India as Commander-in-Chief. The work which he did in reorganising the Indian Army, in the building of strategic railways, in making yet more solid the defences of the Indian Empire, is known and appreciated by us all. Seven full years he spent in India, and in 1911 he was appointed British Agent and Consul-General in Egypt. He went thither in troublous times. Sir Eldon Gorst, at the instigation of Sir Edward Grey, had been attempting to introduce the doctrines of Tom Paine into Egypt. It was not his fault that he failed. He was but carrying out the designs of the Government at home, and, as he said himself, of the British People. Now the Government at home consisted of pedants, who pretended to believe that democracy was a cure for all the evils of mankind; and the British People, which did not know where Egypt was, cannot be accounted a good judge of what was needed for the pacification of a strange, unfamiliar land. Had Sir Eldon Gorst been wisely guided, he would have resigned rather than attempt to force representative institutions upon a country, of whose 11,000,000 inhabitants only 600,000 could read and write. His was the mortification of seeing disorder and discontent overwhelm the people which it was his duty to govern. And when Lord Kitchener succeeded him there was work to do which only a strong man could accomplish successfully. After two years of resolute government, Lord Kitchener had the satisfaction of restoring to Egypt law, order, and prosperity, and of bettering vastly the lot of the Fellaheen.

In 1914, by a fortunate accident, for which we shall ever be grateful, Lord Kitchener was in England. There was an imminent danger at the outset of the war that Lord Haldane should return to the War Office, and that England should be satisfied with exerting her supremacy at sea. The country clamoured for Lord Kitchener, who, already on his way to Egypt, was hastily recalled. Then began his reign at the War Office, which turned England into a military nation and enabled us to throw large armies into the field. The difficulties which lay in Lord Kitchener's way would have

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daunted a less intrepid spirit. An office arranged to administer a small army had to be transformed to an organization capable of equipping, training, and supplying millions of men. And a yet greater obstacle was thrown in Lord Kitchener's path. He knew little of England, and nothing whatever of English politicians. He had spent all the working years of his life in the East, where a man may do his duty without measuring the pressure of this or that colleague, without being asked to oppose the intrigues of men who should have given him willingly all the aid that he asked. Hard as the task was, Lord Kitchener faced it with equanimity and success. He baffled the politicians. He enrolled his armies at home, and he stood abroad for the symbol of British courage and British resolution. All that we owe to him we shall know only when in the fulness of time the history of the war is written. Meanwhile we may gratefully acknowledge two immense services, among many others, which he did to England. At the time when foolish optimists were loudly declaring that a victorious peace would come within a few months, he deliberately and firmly prepared for a long fight. "Three years or the duration of the war"—the phrase was heard on all sides, and was a public guarantee that Lord Kitchener at least did not underrate the heavy work that lay ahead of us. And then the magic of his name attracted thousands to the colours. He achieved what might have seemed impossible. He raised an army of millions where no army was, and he inspired the British nation with the valour to fight, and the hopeful assurance that victory would be theirs. This Lord Kitchener did, and none other than Lord Kitchener could have done it. It was a favourite saying of his that "the work matters, not the workman." And with this thought in his mind he died, we are sure, serene and contented. The workman had done his work, and the work will endure, even though the tireless soul that did it lies fathoms deep in the North Sea.

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THE JUNCTION OF THE INDIAN AND RUSSIAN TRIANGULATION WORK IN THE PAMIRS.

(*Continued*).

THE TRIANGULATION ON THE TAGHDUMBASH PAMIR TO THE RUSSIAN STATIONS.

By LIEUT. (NOW CAPTAIN) K. MASON, R.E., *Assistant Superintendent, Survey of India.*

A word is necessary on the subject of the country over which the triangulation had to be carried and on the climate. Colonel Tcheikine, of the Russian Triangulation, had completed his work in 1912, finishing up on two stations, one on either side of the Beyik Pass on the Russo-Chinese border. Reconnaissance was carried out in 1912, which showed that it would be impossible to utilize either the Kilik or Mintaka routes for connection to the Indian work, and anyone who has been along these "roads" will readily understand the reason of this. It is extremely difficult to get out of the Upper Hunza gorge, owing to the precipitous nature of its walls; and it was therefore hoped to take the series up the Chapursān and connect across country at the head of the Derdi and Hark Nalas; the only alternative to this was a system of very small triangles along the bed of the Hunza River, which would have accumulated a large error.

The general idea taught at school is that the Pamirs are a tableland. But anything more unlike a tableland, which seems to imply something level, could not be imagined. I have tried to bring into line the general idea with the actuality, and if one is to call the Pamirs a plateau or tableland, one may liken them to a table with a rough cloth over which the gods amuse themselves by playing "blowing the feather" from one end of the table to the other. The cloth becomes crumpled and torn, the wind cold, and the unfortunate human feather leads a most unenviable existence.

Lord Curzon estimates that the plains or valley portion of the Pamirs constitute less than one-tenth of the whole mass.*

However this may be, triangulation on the Pamirs cannot be considered uncommonly difficult, provided the detachment remains healthy. This is the whole crux of the matter. The mountains are generally high, the summits of those suitable for survey stations averaging somewhere between 17,000 ft. and 19,000 ft. Their ascents

* *Geog. Journal*, Vol. VIII., 1896.

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are not difficult when once the observer comes to look on laid snow as a friend and not a foe. Handholds are rarely required, and in my opinion there is much more pleasure to be derived from climbing in June on snow than later in the season when the slates and shales are exposed and make the going very tiring. Many of the detachment who did not care for the snow at first would have given anything for a hard snow climb later in the year. Provided one can keep warm and fit, get enough to eat, and has luck with the weather, the rest is more or less plain sailing. Above all else, the necessity of sufficient and suitable food is overwhelming; it keeps one warm, healthy and cheerful, and stores up the essential energy. It is easy to keep warm, even without fires, though I am told that it freezes every night on the Taghdumbash. We never indulged in fires or stoves, as fuel was scarce and only consisted of yak-dung, and a sufficiency of warm clothing was a far better substitute. But the food question was a more difficult one to solve, with our limited experience.

The Pamir detachment consisted of Hingston and myself, 10 Gurkhas, about the same number of servants, orderlies, native guides and interpreters, and some 70 or 80 permanent coolies. To keep roughly 100 men rationed in a country that only produced milk was a constant source of anxiety. We bought *ata* from Hunza territory and more was promised later. Once on the Pamirs we wrote to and had a promise from the Amban of Tashkurghān for any amount of *ata* up to 8,000 lbs., but owing to failure on the Hunza side and the arrival of Chinese troops at Tashkurghān, we were for a time reduced to half rations. I had then to dismiss some coolies and this cramped our action to a certain extent, necessitating lighter and more uncomfortable camps, with their attendant consequences. The signallers were each supplied with a mate for cooking purposes and two coolies for collecting yak-dung for fuel, etc.; this was a minimum for them. The main lesson learnt from the work in 1912 was the futility of trying to carry on in these parts with insufficient men.

The ration for all men was 2 lbs. of *ata* per day, and they could sometimes supplement this with sour curds and milk, an occasional sheep, goat, ibex or *poli*. While this ration could be maintained, there was never any sickness, except in the case of one khalassie who suffered from mountain sickness the whole time and had to be left in the depôt camp at Mintaka Akhsai; besides this there were a few cases of local mountain sickness amongst the men. It was noticeable that one district was far worse than the rest in this respect; this was Kilik East h.s., which was particularly bad just before the beginning of a week of very vile weather. I think everyone was distressed when breathing on this occasion, even the Sarikōli interpreter with us, and a Sarikōli dog was actually sick.

Whether this was "regional" or "seasonal" sickness, I cannot

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say; possibly the latter, as on two later ascents of the same station the distress was not so great. One of the party quite lost his appetite towards the end of the season, but this may have been due to the unappetising nature of the fuel, which though serviceable when dry, caused an unpleasant odour and *taste* to pervade cooked food during bad spells of weather.

The signals used were, in nearly all cases, helios, and I should here like to pay a tribute to the signallers and khalassies, who had a very hard time of it on the whole, and suffered much discomfort.

The Pamir detachment began work on June 4th, the day after our arrival on the Taghdumbash. Helio men were sent out to Dastur and Lup Gaz, and a reconnaissance was made from Mintaka Akhsai h.s. Helio communication was established with Dastur, but the men sent to Lup Gaz failed to reach the summit owing to soft snow, and a reserve party, quickly put through their paces by Naik Bulnar Sing, 9th Gurkhas, was sent in their place, and ordered up the next day. On the 5th, we marched to below Takhtakhūn and on the following day took a light camp halfway up the hill and camped at about 16,000 ft.* The route led up a left bank tributary of the Karachukor and was quite easy. On the 7th, sending our light camp down with orders to pick up the base camp on the Karachukor and march round *viâ* the Chinese post of Beyik to a point in the valley of that name east of Takhtakhūn h.s., we ascended the latter, and found Bell's signal and mark intact. The tent signal had fallen slightly over to one side, and was partly buried under snow. We had only intended to reconnoitre from here on this occasion, but the climb had taken us less time than we had expected. The route led up a steep snow couloir to some gendarmes and then followed the ridge for about a mile, and the early start made the way quite easy. The day was brilliant, and we were able to do some observations, while Hingston carried on the photographic survey. Abdulla meanwhile reconnoitred for a way down into the Beyik Valley, but as it was getting late when we left the station, and his route was on snow with a tendency to avalanche, we selected a better route later in the day. The triangulated height of Takhtakhūn is 17,595 ft.

On the 8th, two Cossacks visited our camp and after inaugurating a new *entente cordiale*, with not a little success, we marched to below Sarblock h.s., the Russian East station, and made our plans for the next day. One signaller had been despatched to Tongder h.s., with orders to expect a call on the 9th, and after a very early start owing to the presence of a large number of ibex in the neighbourhood, one of which was bagged, we ascended Sarblock, height 17,284 ft., and

* The mean of two aneroids gave 16,350, but varied so much on different ascents, that the heights by this means are unreliable.

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found the Russian signal and Bell's mark intact. The station was an easy one to climb, but unfortunately the day was none too fine and towards evening slight snow fell. For a time, however, we had a fine view of the Russian Pamirs and of the Sarikōl Range, the latter trending away northwards. I think that the summit of Mustagh Ata, "the Father of Ice Mountains," 24,388 ft. in height, might have been visible from here if the view in this direction had not been spoilt by the heavy clouds. The Russians used an opaque signal and as such it was a very good one. Four inclined poles met above the mark, and at their junction there was a fifth and vertical one carrying the remains of a flag. This admits of a theodolite being placed over the mark and under the signal without disturbing the latter. A similar mark was observed on Kukhtek (Russian West) h.s. (height 17,031 ft.), the observations from which were completed in 1912 by Bell. The signaller who had been sent to Tongder signalled to us from a spur that he had been unable to reach the summit of the station, so we had to make up our minds to follow him on the 10th.

At this time our camp contained a curious variety of races and religions. Besides the Cossacks and their Chinese servants, there were men from Hunza, Baltis, Gilgitis, Kashmiri Mahommedans and Hindus, Sarikōli Tajiks, Gurkhas, one Englishman, one Irishman, and a down-country Mahommedan cook. On only one occasion did I ever notice the slightest unfriendliness between any two men of different races, and this was between a Hunzakūt and a Sarikōli headman who had given him an order. With this one exception which was quickly settled, the most cordial relations existed in the whole camp.

The Survey detachment had now been in the three biggest empires of the world, the most complex, the most ancient, and the most autocratic. After a journey lasting exactly two months since the day of leaving Dehra Dun, we had reached the Russian stations, and were ready to begin observing on the way back. Everything seemed to promise well; there had been no sickness, it seemed as though we had nothing to worry about as regards food; the Sarikōlis were most friendly and hospitable, and the weather had given us the most promising indications.

On the 10th, however, we awoke after a dismal windy night to find the whole place a dreary white wilderness of snow, and snow was still falling with a silent steady monotony that gave us the impression of a glimpse into eternity. With scarcely a break, this continued throughout the 11th and 12th, but an apology for a clearance occurred on the 13th, and we were able to move camp a few miles to the mouth of the Tongder Jilga. But snow came down on us again about midday, and we were forced to pitch camp.

On the next day we left camp at 5 a.m., and went up Tongder

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h.s. (17,611 ft.). The going was not difficult; in fact we did not have a piece of really interesting climbing the whole season; but the snow was new and soft, so that we sank in places up to our thighs. Even so I think we were better off on this occasion than we should have been later in the season, when the route would have been either on loose rocks or shale. I observed to a few intersected points, as Bell had completed the stations the previous year, but the weather was vile, and snow constantly fell at intervals. The wind was also very strong and I used the observatory tent. I afterwards gave this up as I found much time was wasted by not having the right window open when wanted. It was more unpleasant without it, but I do not think the observations suffered, and when in a tent in a high wind I was always in a mortal terror that the tent would be carried away. On this occasion as on several occasions later, the ink froze, so that we had to record in pencil. We took the signaller up with us, but he suffered from slight mountain sickness, as did one other of the Gurkhas. About 12.30, we decided to return, and we had a great "joy ride" on the snow on the way down. The snow was in excellent condition for a plunging glissade, and of just the right consistency to make the pace exhilarating.

Having deposited our signaller in a low camp about 15,000 ft., we marched in the gloom of another snowstorm down the Beyik, to below Takhtakhūn h.s. *En route* we received reports from our signallers of the joys of the camps at high altitudes, but could do no more than rave against the fates, the gods, and the weather. On the 16th, it really seemed that our curses had had some effect and we started off for Takhtakhūn, but only made some 2,000 ft. before the snow came down again. The next day we were away before 5 a.m. hoping against hope the weather would change for the better, but on reaching the summit, it turned as bad as ever, so we pitched our 16-lb. Whymper tent, packed a few people in another, and sent the rest down. Towards evening, we were able to get some observations completed as the weather cleared and one sportsman in the 9th Gurkhas had returned as soon as it was possible.

> ". . . The delighted spirit
> To bathe in fiery floods, or to reside
> In thrilling regions of thick-ribbed ice."

We then dined off ram-chukors' eggs, a rare occurrence and one which, incidentally, we regretted afterwards, as we did not come across any more. As we had had a message that the helio men had been unable to find the Tomtek mark we decided not to wait, but to push on and return when we were certain that this station was correct, and in the meanwhile we sent our Sarikōli interpreter, Arzu, an excellent man in every way, to help the helio squad. Early on the 18th, we sent word down to our low camp for a double march

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up the Karachukor to Kuss Kussu, and ourselves marched there, arriving at nightfall below our next Survey station, Dastur. Our bedding did not turn up, so we slept in hope and our clothes.

The 19th deserves a new paragraph, for it was cloudless throughout. We were, however, a little late in getting off, because the march on the 18th had been rather too severe on the coolies, but we reached the station of Dastur by 2.30 p.m., and called up most of the stations, the Gurkhas turning out of their tents, like marmots after winter. The Lup Gaz helio did not show, so we had to return on the 20th, when we had more luck and were able to finish off the work. The return journey, which afforded a pleasant glissade for nearly 3,000 ft. was accomplished in about half an hour. On the 21st we took a light camp up Mintaka Akhsai h.s., completed about half the observations, and the next day finished off and came down to our depôt, where we had a wash and brush up, which we were sorely in need of. Perhaps it is nothing to be proud of, and not quite the thing in civilized countries, but it is a fact that we rarely undressed for the night, had a bath, or were able to change our clothes. It was either too cold or we had no time. In this we more or less followed the prevalent custom of the country. But as regards washing our faces there was no skin to wash, for the snow and wind were already playing havoc with the raw flesh beneath.

After a short march on the previous day, on the 24th we left camp at 5.30 and, taking a light camp, went up Tomtek; we completed all the observations to those stations on which helios had been placed, were able to send the camp back again, and follow in the evening. This was our highest station up to date, 18,608 ft., and it was very tiring keeping on one's feet for five hours on end after a somewhat strenuous climb.

Tomtek is one of the highest mountains in this part of the Pamir and everything appeared spread like a carpet crumpled beneath us. It was indeed a magnificent sight and the mountains we had already been up seemed almost insignificant. The station mark-stone was let into the ice cap, which we eventually found to be a cornice.

From here we saw a literal waste of mountains, which for ever rooted out any idea of a tableland that may have been lurking anywhere in our thoughts before. In every direction there was the same interminable range upon range, the same stupendous desolation, planned without any apparent form or thought. It was the Earth of B.C. 4004, and a sight to stagger the imagination. The three greatest Empires of the world lay at our feet, and whichever way we looked, they appeared desolate, uninhabited, and uninhabitable, a seeming maze, as though Nature had tired of method and cast the surplus of the earth's crust down here, hoping that no one would find her out.

On the 25th we divided the detachment, and while Hingston kept

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on with the photography, I doubled back with a squad to Takhtakhūn h.s., and owing to a very early start on the 26th, we finished the work to Tomtek and Dastur, and on the following day returned to our depôt. While on Takhtakhūn h.s. on this occasion, a khalassie, while building the cairn, dropped a boulder on my knee and lamed me for a day or two.

We now intended to take a rest, as we had been up four stations in eight days, often with long marches between, and while at Mintaka we had an opportunity of observing our surroundings more closely, and I extract the following note from the doctor's journal:—

"The fat-tailed sheep which the nomads tend are interesting. In the winter, when food is scarce, the fat in the tail disappears, and in the summer accumulates to such an extent as to form a large rounded mass projecting from the hinder extremity of the animal. Thus does Nature convert that mysterious animal appendage—the tail—into a storehouse for food, which in time of need, the creature can burn up and use for fuel in its economy. The shearing season has just passed and most of the sheep are bare of their wool, with the exception in many cases of a large area over the buttocks, which has not been deprived of its natural covering. I was unable to understand clearly why that portion of the animal had not been shorn. The animal's great enemy seems to be the wild dog, which is also said to cause much havoc amongst the *ovis poli*. The Sarikōli uses the domesticated dog for protecting their flocks against its wild congener."

We had a little trouble with one yak owner on this day. Most of these people have a very poor idea of the value of money. They can get very little in Tashkurghān, and so, when one pays for anything in cash, one has to realize that to be a fair exchange, one must pay for time wasted in getting things the ten marches from Kashgar. Bell realized this, and produced a wonderfully fair rate for everything he or any of his men might want, and himself insisted on these rates being paid. The rate for yak transport is well known—one rupee per day for any march whether for half a mile or 30 miles. This is quite fair, because a yak needs no tending when halting, and he will go apparently all day without worrying. Bell also used to pay the same rate for a milking yak. One beg, Kumalik, however, had a very fair idea of the value of ready money, and besides being quite incapable of counting above ten, he could see no reason why we should not pay a rupee a day for a milking yak and a rupee *for each of her two calves*, though the latter were actually fattening on our milk. We eventually gained our point, but during the negotiations, he had been rechristened "Bukhwassie Beg"—the bukhstick. I was afterwards told by a Sarikōli that the name had stuck to him and would remain with him till his dying day.

On the afternoon of this day the camp presented quite a gala

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appearance, all the Gurkhas getting hold of Sarikōli wedding garments (mostly feminine attire) and coming to us to be photographed. The kit may be described aptly by the word "loud," but detailed description is quite out of the question.

On the 29th, we had intended to move camp, but early in the morning a Chinese officer came to call on us, having as he told us lost his camp. So we remained one more day to entertain him. Yung Chung Lun was still in possession of his pigtail and quaint kit with his absurd little straw hat, but the Republican *hukm* had arrived and he told us that pigtail and kit had all to be changed within the month. He rather liked our brandy, and we toasted a new entente to "*Askola.*" Conversation was carried on through two interpreters—through the medium of Turki. After tiffin, when the fact that he had had enough was made known to us by the expressive remark that his head was going "*hulta-pulta,*" we found that it was nearly tea time.

We had arranged to meet McInnes about the 1st on the Kilik Pass, so on the 30th, we marched to Taghramansu, westwards up the Pamir, and on the following day reached the Kilik Pass, after a halt in Tulboy's hospitable khourgas, where after much *kow-towing* and *askolas* we bade adieu to Yung Chung Lun, who asked us to stay with him at Tashkurghān. On the way we had an interesting experience in the shape of hunting. Arzu's dog entertained us by stalking and killing a marmot, much to the admiration of my dog Smiler, an optimistic enthusiast, but one who had no idea of hunting for his own food. At the top of the pass we heard that McInnes was in camp at Bun-i-kotal, and sent word to him to meet us on the pass the next day. His chief trouble was the link between the Chapursān and the Kilik, and I believe he had by far the most difficult country. His climbs were worthy of the name, and he was near enough to the Pamirs to get most of the bad weather. He looked thoroughly worn out and from now onwards his health caused us all an extra anxiety. But he stuck to it like a Trojan, and was the last to finish work.

Our food question was now beginning to cause us some fears, as the promised convoy from Hunza was a fortnight overdue and all the men were on half rations; we fell back on the Amban's promise, but as bad luck would have it, a regiment of Chinese troops had arrived in Tashkurghān and commandeered all supplies. The local begs then came to the rescue and supplemented the small ration with "*lassi,*" or sour curds, and I can never be grateful enough to them for all the help they gave me during this time. At the same time I had to reduce my squad and send some men back.

It was bitterly cold on the pass and I believe the wind is always the limit here. It defies description. Heavy dark ominous snow clouds were gathering towards evening, and on the 3rd July after

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ascending the new station of Kilik East (height 18,203 ft.), we commenced to clear the cornice away; we soon found this was too much of a task, and would have taken us days; so we had to build a large platform from which we could see over the cornice to the north.

Our camp was not with us so we came down some 2,000 ft. for the night. The following morning it was distinctly dismal when we woke up. The country had again become a vast white desolation, and snow was silently falling. Dark threatening clouds loaded with misery rolled overhead, and we remained in our sleeping bags all day.

On the 5th, we again went up Kilik East h.s. The new snow had completely changed the aspect of the country, but the day seemed as though it intended to be more obliging. It was weary work ploughing through the freshly-fallen snow, and when we reached the summit, and set up the observatory tent, the weather had again changed for the worse, and we had nothing to do but crawl back into our sleeping bags, and listen to the *thud-thud* of the snow outside. We were immensely cheered towards evening by the arrival of news that the Hunza *ata* was only two marches off, and it seemed to give us a new hope. The next day was the same monotony redeemed by one faint glimmer of a sun. Twice we left our sleeping bags and cleared away the snow from the observatory tent, and set up the theodolite. But almost at once we had to pack up and crawl disconsolately back into comparative comfort. A coolie, one of the best, arrived in the evening through the blizzard, and found his way to our high camp on the top of the hill with a dâk, the most welcome we had ever received. But there was bad news. McInnes and Collins were having greater trouble than they had expected, owing to a fault in the reconnaissance, and I was asked to observe from the two Kilik stations to the south. This meant that I should anyhow have to revisit Kilik East h.s., so there was little further use in my remaining on the station now, and on the 7th, after again experiencing the same snowy weather, we decided to leave and complete the work on the Pamirs itself. Desolate as the pass seemed under its white pall of snow, it seemed a veritable paradise after the discomforts of the last few days, but we did not linger, and made our way to Tulboy's khourgas, where we were the recipients of his generous hospitality. We exchanged presents, and then had our first bath for over a week.

In the morning the weather was brilliant, and we marched to the Jalung Jilga, and on the following day ascended the hill station of that name (17,510 ft.). It was a perfect day, and all the lights showed except one. This we afterwards found was due to both the signaller and his mate being temporarily unwell, and luckily we did not wait. We came down the same day, and followed with an evening march to a spot below our next station, Karakokti (17,708 ft.).

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On the 10th, we went up this station in fine weather, observed to all stations and points, and returned to our low camp.

On waking up the following morning, I found I was snow blind, as was Kulbir, of the 5th Gurkhas. Observing in a snowy land is rather hard on the eyes, and from now onwards till the end of the season my eyes gave me trouble, particularly after a long day's observations. On this occasion I made someone lead my yak to our next camp below Tomtek, from which station we were now going to observe to the forward stations. We met Blandy on the way, who gave us an account of his shooting luck, and he camped with us for the night. He had examined many of the minor valleys in search of *ovis poli*, and had secured some of the best heads in the district. In addition he was able to add to our scanty knowledge of some of the outlying parts of this Pamir. My recorder, Pandit Aftab Bhan, had an accident during this march and was put *hors de combat* for a month, and Hingston very kindly offered to undertake the duties instead. I can never be sufficiently grateful to him for this, and undoubtedly he saved me by this means a large amount of trouble.

We had a great day on the 12th. At the first streak of dawn we did a long trek up Tomtek. There was less of the winter snow than on our former visit, and the new snow had cleared away by now. Again we had the perfect view from the top. Somehow one felt that this one view was worth any amount of discomfort. My eyes were causing a good deal of trouble, and owing to the constant rests that I had to take from this cause, observations were very slow. But all the lights were showing up well and we were lucky in getting the work completed; we were thus able to return to our low camp the same day, arriving just before dark, after a glorious and exhilarating "breeches glissade" for some 3,000 ft. We collected a good many specimens of the flora on our way back to camp, for the side valleys were by now enjoying their spring, and, comparatively speaking, the land near the waters of a tributary stream was really almost fertile.

On the 13th we marched to Lup Gaz Jilga, halting *en route* at our depôt for lunch. We camped on the spot where Harry Bell had died almost exactly a year ago. Harry had endeared himself to all these people during his stay on the Pamirs; Arzu told me he had never met anyone who had set such a high example. He refused to contemplate that he was near death, and when McInnes arrived after a long day's ride, Harry had told him to go and get some rest. This was the brave spirit that could think of others, when at death's door, and the impression that this act had on the people was only equalled by the calm resignation with which he faced the end alone. Those who knew Harry best, knew his sterling worth and his splendid qualities, and to some extent can gauge the loss. But it needs a visit to the lonely spot where he died, to get a glimpse of what his

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thoughts must have been, and get a true answer to "cui bono." A man more unselfish and unconcerned for his own estate, it would be hard to find, and a more conscientious observer is an impossibility. In a letter Colonel Tcheikine wrote to me from Tashkent, he said "Quant à moi, je suis fort heureux d'avoir pris part au travail universel, avec nos amis les Anglais, mais mon bonheur fut assombri par la mort soudaine du jeune, intelligent et sympathique compagnon de travail, que fut Monsieur le Lieutenant Bell."

At Lup Gaz we built a large cairn to his memory, with a suitable inscription cut in granite, the work of some hours. It is not often perhaps that Mahommedans will apply for permission to build a shrine to the memory of a Christian, but it was so in this case, and I found that the Sarikōlis already knew this valley as the "Bell-Sahib-i-Jilga." His example will remain in the memories of these people for many years to come.

We completed the observations from Lup Gaz, 17,695 ft., on the 14th, and on the next day did a short march to our depôt. It snowed slightly during the day, but nothing to speak of. We had found that the helio men on Lup Gaz had been unwell and we had left a squad to relieve them; so now that we were certain of a light there we returned to below Jalung Jilga h.s. and camped in the Kara Jilga. On the 17th after sending our camp on to Kukturuk, we climbed the station by a ghastly route on shale, finished the observations and followed on yaks to our camp below Kukturuk h.s., arriving about nightfall.

My eyes were rather strained again, but we finished Kukturuk off the next day, being able to ride yaks up the greater part of this, one of our lowest stations. We had been expecting a dâk for nearly three weeks now, and since the bad news from Collins and McInnes on the 6th we had heard nothing, and were getting anxious; a helio message came in from the signallers on Kilik East that they had been watching to the south for some days and had seen no flash from McInnes' helios. I was suffering from an attack of rheumatism, so we decided to remain here for two or three days. Five stations had been ascended and observed from in ten days, which of course had meant very early starts, and late arrivals into camp of an evening. There was always heaps to be done in the evening after dinner, developing the survey photographs, checking means, and writing up a duplicate angle book and notes of the day's work. Hingston generally had in addition to helping me with this, his birds to classify, the flowers to press, and on colder nights, a good deal to say on such subjects as Home Rule, the suffrage question, and Mr. Lloyd George. We both heartily disagreed on these subjects, and found it an admirable way of getting warm. It snowed and blew most of the night of the 20th and we expected another bad spell, but this time it passed off without doing us any harm.

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I felt very rotten for two days, but was much better after a rest, and on the 22nd, we went back to the Kilik Pass. We went up Kilik East h.s. again on the next day and camped there, but I was not fit enough to take any observations. The following morning, however, Bulnar Singh was out early getting in touch with the various stations, and we were relieved to hear that McInnes had finished observing from Tong-i-tuk (the old Hark station), which he had ascended from the south, after a very hard time. After finishing the observations we came down to our Kilik Pass base camp, where we remained for some days because McInnes sent us word that he wanted the helios. Helio communication was maintained with Kilik East, so that we could know when McInnes had finished. Hearing no news, on the 28th, we went up Kilik West (18,020 ft.), to try and find out what had caused the delay. The Pamir observations were finished off the next day, and those to Tong-i-tuk on the south, but McInnes had not yet signalled through Lupjangal hill station, and we afterwards found he had mistaken the hills. A cutting snowstorm made things unpleasant in the afternoon and we returned to the more congenial atmosphere of the pass. We were again running short of food, owing to the failure of the Chinese supply. McInnes was also in difficulties for want of food, and expecting every day we should be able to finish off our work, we sent him 800 lbs. of *ata*, again went on half rations, and sent out a foraging party under our Hunza havildar; again we were helped by the generosity of the Sarikōlis. A few sheep were bought at ruinous prices.

On the 30th, it was decided to go to McInnes and lend him some help. Some Khirgiz had come in from the Russian Pamirs for medical treatment and Hingston attended to them. Though there was very little medical work for Hingston in our camp, scarcely a day passed that some nomads or tribesmen did not come in for treatment, and Hingston at all hours of the day was to be found busy healing their infirmities. He gained a great reputation, and men would come as much as ten marches for his cures. This left a great impression on the people, and to no small extent contributed, by the good effect it produced on them, to their kindness to us.

These Khirgiz were a very different type from the Sarikōli Tajik we had been accustomed to. All the Mongolian nomads have left the Taghdumbash, and trekked to the sphere of Russian influence. They possess no land or houses in Tashkurghān, and so are quite free to travel from one country to another and become the subjects of any Power, without fear of losing anything by so doing. The fact that the Khirgiz were liable to taxes to both the Chinese and to Hunza was the primary cause of their removal to Russian territory. Colonel Sir Thomas Holdich, after the Pamir Boundary Commission of 1896, wrote as follows:—"There being but a shadowy line of

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distinction drawn between the Khirgiz tribal divisions, all of which appear to follow their yearly migrations in search of pasturage on lines which are quite irrespective of national frontiers, we may expect that the whole Khirgiz population will soon be under the domination of the strongest power, possessing the largest share of Pamir. According to information obtained by General Gerard when personally investigating the subject, the Chinese taxation of the Khirgiz is of the most nominal description. All skins of wild animals killed (except *ovis poli*) are given up as tribute to the Amban of Tashkurghān, but no money payment whatsoever. To their own begs, they pay 1 per cent. annually of all their flocks. Such easy terms are no doubt attractive, but will not suffice to keep Khirgiz nomads permanently from Russian influence." *

Sir Thomas Holdich's prophesies have come about, and there are now no Khirgiz living on the Taghdumbash. It is possible that this was hurried by the fear of a money tax, such as the one imposed this year by the Amban of Tashkurghān on the Sarikōlis, and which they have flatly declined to pay. From what we could find out by questioning, the grazing on the Russian side appears to be far richer than that on the Sarikōl. Sir Thomas Holdich records that the grass on the Great and on the Little Pamirs is extremely rich; this is certainly not the case on the Taghdumbash, where the only grass suitable for grazing exists near water and the snow line. Again, in the days of the Commission, it is recorded that the Russians had created a very high rate of payment for all sheep and live stock purchased from the nomads, and had insisted on the strict compliance of this order; and one officer was given a week's arrest for disobedience in this respect. They do not appear to be so particular nowadays.

The reason that the Sarikōlis have not followed suit, appears to be from the fact that they possess houses and land in Tashkurghān, and they seem to be unwilling to give these up, as they would undoubtedly have to do if they were to migrate to the Russian sphere of influence. But it is just possible they too will leave the Taghdumbash if the Amban insists on a money tax.

On the 31st July we marched down to Murkushi, and after our average height of over 15,000 ft. for the last two months, it was like getting down to sea level again. How can I describe the joy of seeing real trees again? Murkushi, which on our arrival two months before had seemed the end of the world, now appeared a regular harbour of civilization. The dwarf willow forest gave us more delight than a walk in Greenwich Park, and I shall always connect willows with this part of the Empire. We camped there

* Report on the Proceedings of the Pamir Boundary Commission, 1896.

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for the night and on the 1st August moved out with a very light camp to meet McInnes. After going, however, a couple of miles we received a note from him, saying he was on his way to a forward station, and would be connected through to the Pamir work by the time we could reach him, and that there was no object in our going to him. We therefore left our heaviest kit at Murkushi, and on the 2nd returned to the Kilik Pass, and camped there for some days, anxiously waiting for news. On the 4th we had a helio message from McInnes, through our signaller on Kilik East h.s., to the effect that he had climbed a peak from which he could see Kilik East, and that he intended to connect from this; also that he would observe if fine on the following day. The weather again turned bad during the evening, but the 5th was better, and we went up Kilik East h.s. and found that McInnes was observing to that station. We pitched our 16-lb. Whymper on the summit, and the weather drove us into our sleeping bags early; it was very cloudy all night and a violent snow squall threatened to keep us there for some days.

At last, however, on the 6th we got into touch with Murkushi h.s., and were able to complete the observations and come down, before the clouds obscured the hills. Duffadar Beg put us up for the night, and presented the coolies with a sheep to celebrate the success of the work. We now had no doubt that the work would be finished, for the worst had been done, and there only remained the Chapursān stations. We now hoped to get in ten days' work with the survey camera, and fill in the blanks that had necessarily to be left out during the more important work of completing the link. But we were caught in bad weather near Taghramansu, on the 7th, and on the following morning we awoke to find the ground right down to the Karachukor under a white mantle of snow, while clouds hung very low on the hills. Morning after morning the outlook was the same, the worst spell we had had since our arrival. The clouds seemed to be driven backwards and forwards, up and down the valley, each time the snow being driven almost horizontally, so that it was impossible to see anything. We had now been on half rations for nearly a fortnight, and two maunds of *ata* foraged for by Humayun had been left the other side of the passes, as soon as the weather turned bad. Our ten days' work with the camera had to be abandoned on the 12th, on the morning of which day we only had four days' half rations left, and still the day's ration to issue. The wind was very biting and cold on our way to our depôt at Mintaka Akhsai, and we sheltered from the storm at Faqir Shah's encampment. We bought two sheep at 10 rupees each at Mintaka, as the Sarikōlis were in the same straits as ourselves as regards *ata*, which had gone up to prohibitive prices at Tashkurghān, and was now being refused to them at any price. In the evening, however, three maunds arrived from the foraging party in Hunza, and we felt more comfortable.

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Early the next day we started to pack up our depôt, and were able to cut down our kit to a large extent, by the distribution of warm clothing, tins, old bottles, etc., to the Sarikōlis. These latter were immensely appreciated, as were old kerosene oil tins, and it is a useful thing to know that these men almost prefer them to any other form of bakhshish. In the evening a little more *ata* arrived, and I was even able to repay Mahomed Beg for some of his kindness with a present of *ata*, of which he had run out. It was the same dreary day, similar to the previous fortnight, and our last day on the Pamirs was scarcely better.

On the 14th we returned over the Mintaka, a snow squall driving us to shelter in the dâk hut on the summit of the pass with most of our coolies. Now that we were leaving the Pamirs for good, one could not help doing so with a feeling almost akin to regret. It is a desperately inhospitable country where hospitality amongst the tribesmen is a religion. We took away with us memories of a wonderful land, and of a wonderful people, whose kindly characteristics and generous help had lightened our work to a very considerable extent.

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REVIEWS.

HISTORY OF UNDERGROUND WARFARE.

Being a Review of the book by A. GENEZ, Captain of Engineers, French Army.—(Librarie Militaire Berger Levrault, Paris, Rue Des Beaux-Arts 5–7, 1914. Price 5 francs).

(*Continued*).

FOURTH PERIOD.

Under Louis XV., Marshal Vallières and his son did much to improve the artillery, but it is to Gribeanval that we owe the mobile and powerful weapons in vogue during the revolutionary campaigns. These were wars of manœuvre and movement, hence sieges were exceptional, and even at sieges long range weapons placed beyond the glacis were able to breach the parapets. The continuous enceinte was superseded by detached forts, which, as ranges increased, were placed further and further from the point to be defended. These circumstances limited the use of mines, which were little employed except during the Peninsula War. A few other cases may be mentioned, such as the Siege of Valenciennes in 1793, where the Allied Army under the Duke of York succeeded after a month's labour in laying three mines each containing 4,500 lbs. of powder. Owing to delay caused by want of information, countermining was tried too late, the mines were fired and an assault delivered. It failed at the time, but the town was surrendered three days later.

At the Siege of Acre in 1799 the salient of the counterscarp was blown in by a mine, but two assaults following it were repulsed mostly owing to flanking fire from a high tower on the walls. A deep mine, to blow in the tower, was then commenced. The Turks countermined, but too high. Three mines were fired under the tower, and one under the glacis to fill the ditch. The tower was not greatly damaged, an assault failed and artillery had to be brought up to complete the destruction. Another assault failed and the siege was raised.

During the Siege of Saragossa in 1809 the French had only captured a small part of the town after 30 days' operations. The Spaniards had collected the inhabitants into separate blocks of houses divided from each other by wide streets or public places, each block forming a separate fortress with some large building in it constituting a keep. The houses were barricaded and loopholed. Frontal attacks were out of the question, and mining had to be employed. The defenders tried to countermine, sometimes effectually, and it was not till 20 days later that the town capitulated.

Mont Jouy de Girone in 1809, and Valence in 1812, where the galleries had to be driven under a wet ditch, were captured by the French owing

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to the use of mines. In 1812 the English employed them against the Castle of Burgos. There were no engineers, the first explosion only demolished the wall of the escarp, and left the parapet above almost intact, a second charge was better placed, and made a practicable breach which was crowned, but all efforts to advance further failed. The work was carried out by infantry, was very slow, and very trying to untrained and inexperienced men.

At the third Siege of Badajoz the fronts facing the Guadiana were the weakest, and the French had strengthened them by an improvised system of countermines. Wellington knew this, and having no engineers could not hope to succeed in a limited space of time in an attack upon this front. He was compelled to try elsewhere, where not only were the fortifications stronger but an inundation gave additional protection. Numerous and practicable breaches were made by gun fire, but the defenders closed them with sandbag parapets, placed chevaux de frise in front, arranged loops of bombs attached to powder hose, and large barrels filled with tarred straw, grenades, and shells, and posted men to set fire to these and roll them down on the assaulting columns. The counterscarp had not been breached, at the foot of it the defenders fixed another series of bombs under a few inches of earth, and connected together by powder hose covered with gutter tiles. These were fired as the English jumped into the ditch, but did not check the assault. Many men were drowned in a deep trench in the ditch. The remainder were checked by the burning barrels. However a party had managed to scale the St. Vincent Bastion and attacked in rear the defenders of the breach, with the result that a capitulation followed.

The mine defence of the Castle of Mouzon is of interest. The castle was held by 100 French gendarmes against 3,000 Spaniards. All the countermines were planned and superintended by a mine watchman named Saint Jacques who had been at the Siege of Saragossa. The only tools at first available were four pickaxes, three spades, three axes, two hammers and two saws. There were no candles or baskets. Powder was procured from cartridges, candles from melted bullocks' fat, and more tools were captured from the Spanish mine galleries. The place held out from the 27th of September, 1813, to the 18th of February, 1814, when the captain in command ascertained that the French were everywhere in retreat, and capitulated. On no single occasion did the Spaniards fire a mine, Saint Jacques and his men were too quick for them, or the mines were destroyed by sorties.

At the time of the Revolution the globe of compression had given birth to several countermine systems, the general characteristics of which were the omission of the envelope gallery at some distance in front of the counterscarp, and the use of listening galleries disposed as antennæ, whether connected together or not by a transverse gallery some distance in rear of the listeners. General Marescot, the first Inspector-General of Engineers, initiated in 1802 a competition for a treatise on mining. This produced the classic works of Mouzé, Gillot, Gumpertz and Lebrun, which obtained first and second prizes, and honourable mention respectively.

Mouzé's system of attack was based (1) on Belidor's idea that it was

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easy to invade the countermines after exposing them by an explosion, (2) on the utilization of Boule's shafts, and (3) on experiments made by himself with regard to the omission of tamping. Mouzé sited his last parallel 52 yards from the nearest listeners, thus assuming *a priori* that the plan of the countermines was known, and from it made a series of attacks by mining without explosives, whilst he pushed on by flying saps over the ends of the listening galleries. There he sank Boule's shafts, which he estimated would take three hours each, placed in each 1,650 lbs. powder, or almost enough to fill it, laid a cover on the top and fired it. Eight miners then excavated in each crater to find the broken gallery, which Mouzé estimated would take an hour, and each gallery was invaded by a party of grenadiers and workmen. They barricaded themselves in the envelope, and thence pushed on to the counterscarp gallery.

Gillot was bolder, proposing to advance by zigzags from the third parallel, and to sink his shafts over, and blow in each listener with 300 or 400 lbs. powder. If the positions of the listeners were unknown, a row of mines at 20-ft. intervals could not fail to find them. Here the fourth parallel was sited, whence the salient place of arms and counterscarp gallery were attacked by shafts. Thus, whatever the countermine system, Gillot in three nights rendered it useless, and reached the counterscarp.

Gumpertz and Lebrun, inspired by Lefevre's advance at Schweidnitz, drove inclined galleries from the last parallel for 35 yards and fired three mines 44 yards apart with as large a L.L.R. as possible. He considered that at 9 yards depth in compact earth, 6,000 lbs. powder should produce craters of which the radius was double the L.L.R. From these craters the attack again advanced, and it was estimated that the counterscarp would be reached and demolished after 45 days' mining, assuming that the attack made no mistake and that the defenders confined themselves to looking on.

From 1815 to 1823 Lebrun was writing a work on countermines. He proposed to build one tier of galleries in earth up to 16 or 26 ft. deep, and if the earth were deeper, two tiers of galleries, the upper to attack the enemy's earthworks, the lower, his mines.

The most striking feature of Mouzé's and Gillot's methods is their overwhelming impetuosity; this probably reflects the military spirit of the times. The garrison would have to be deprived of all energy which could not put a stop to the sinking of the shafts; even if too weak to make a sortie it could considerably delay the work by plunging fire from the ramparts. The firing of even one countermine would send the workmen back to their parallel, and it would be difficult to induce them to face the work again.

This bold method of attack by shafts, however, produced modifications in the design of countermines, and in 1820 Colonel Rohault de Fleury invented a system of "countershafts," *i.e.* mines placed over the ends of the listeners just underground, so that their craters would give no cover to the assailants, and so far above the gallery roofs that a charge capable of damaging the enemy's galleries, would leave the protected gallery unharmed. This system was only introduced slowly, owing to its practical difficulties. At first excavations were made down

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to the roofs of the listeners, which were protected by shields, but in 1828 Colonel Thuillier invented the first camouflet machine, which enabled the deep excavation, and consequent disturbance of the soil over the gallery, to be omitted. It also permitted of placing the mine from the gallery, and loading it by cartridge. These mines were then called "countershaft camouflets." The *attaque brusquée* was thus put a stop to.

Following on improvements in ventilating and firing apparatus, countermine systems were simplified. In the same gallery charges were laid in pairs, that furthest in front was first fired, that in rear, placed in the tamping of the former, exploded into the first crater. The new fuze gave so little smoke, and the renewal of air was so rapid, that it was even found possible to fire the first charge before tamping and firing the second.

Shortly afterwards it became customary to place a charge in position after the tamping was finished; the use of bored mines facilitated this procedure. The idea was not a new one, as a modified form of bored mine had been used at Candia, but now assumed fresh importance owing to the introduction of improved boring apparatus. For a time it was considered that the attack had acquired such a valuable weapon that the countermine was doomed, but practical experience proved that this opinion was not justified. The drill was frequently stopped by stones, or the ground was so hard that large numbers of men were required to work it. The Siege of Sebastopol finally burst the bubble of the bored mine, principally because it was found impossible to expose more than two or three men at a time under curved fire. Boring however still had its uses as a method of underground reconnaissance.

Major Laloy tried at Arras in 1854 an improved method of procedure analogous to that of Lefevre at Schweidnitz, but gave the miner some protection against the countermines of the defence, and considerably shortened the interval of time between each explosion. To fulfil the first condition 5 to 7 ft. of cases were erected and covered with earth in the first craters, which were to be opened by large mines at some little distance from the countermine system. Inclined galleries were then driven as far as verticals through the front edges of the first row of craters. The earth piled on the cases placed above ground in the craters, acted as additional tamping, and prevented the effect of the mine at the end of such a short gallery taking place backwards. If the defenders fired a countermine, part of its effect would only be to throw more earth into the crater and increase the L.L.R. In ordinary ground successive globes of 900 to 1,000 lbs. could be placed and fired at 12 to 15-hour intervals, securing an advance of about 13 ft. on each occasion. The mines were placed in rows close enough together to leave nothing untouched between them.

Thus at the opening of the 19th century the art of mining was held in great estimation, but countershafts, and charging after tamping were hardly applicable in actual warfare. The Siege of Sebastopol demonstrated that the most simple processes were the only practicable ones, but the attackers were confronted by worthy antagonists. The Russians were past masters in the art of underground warfare, and had acquired

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practical experience of it at Brailov and Varna during the Russo-Turkish War in 1828.

The fortifications of Brailov consisted of a semi-circle of small bastions joined by long curtains, the ditch was dry, with revetment walls. The place contained a large garrison, and communication across the Danube was open. There were no countermine galleries. On the 11th night of the siege three covered saps were pushed from the third parallel, two towards No. 1 Bastion, and one towards No. 2. A large mine of 8,500 lbs. powder was placed against the counterscarp between the Danube and No. 1 Bastion, six of 800 to 1,000 lbs. each in a gallery behind the counterscarp on the attackers' left of No. 1 Bastion, and another of 8,500 lbs. under the foundations of the escarp. Two mines of 2,500 lbs. each were placed under the escarp of No. 2 Bastion, and four of 800 to 1,000 lbs. each along the counterscarp. These were to be fired simultaneously in three groups, (1) the large mine near the river, (2) the mines of No. 1 Bastion, (3) the mines of No. 2 Bastion, and an assault launched immediately. The signal to fire was to be three rockets. Unfortunately the officer in charge of No. 1 Group fired after the second rocket, and buried the junction box of No. 2 Group, consequently when the third rocket went up only No. 3 Group could be fired. Practicable breaches were formed by the mines which exploded, No. 1 having thrown a quantity of earth against the escarp opposite. The assault was delivered, but failed, partly owing to the stubborn resistance of the Turks, partly because the right column had to make a flank march, and lost heavily in doing so, and partly because the earth thrown by No. 1 Mine against the escarp slipped down under the feet of the attackers, and was soon too steep to climb over. The left assault reached No. 2 Bastion, but was there forced back, and 1,500 to 1,800 men were lost in a counter-attack. Next day the second group of mines was fired, all the craters crowned, and the ramparts heavily shelled by artillery. A sortie was repelled, and next day the place was surrendered after 24 days of open trenches.

In a report of the siege written by an artillery colonel it is stated that breaches might easily have been made by the guns more quickly than by mines, but the engineer corps dominated the siege, which was conducted by its first Inspector-General. The failure of the second group of mines shows how important it is in war to avoid complicated methods. It would have been better to fire each mine separately. In regard to this criticism it may be considered doubtful whether the artillery could have demolished the counterscarp walls, even if they had succeeded in making practicable breaches in the escarps. Certainly the absence of countermines contributed largely to the rapid success of the Russians.

The fortifications of Varna were much the same as those of Brailov. The Russian left rested on the Black Sea opposite No. 1 Bastion, which was separated from the sea by a ditch 170 ft. wide. The counterscarp was formed by a cofferdam cutting off the waters of the ditch from the sea. Between Nos. 1 and 2 Bastions, at right angles to the seashore, the ditch was 190 yards wide opposite the curtains. In the middle of the ditch was a stream which formed several pools. Trenches were opened on the 7th of August, 1828. The escarp of No. 1 Bastion was

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soon breached by gun fire, and opposite the breach five shafts, 56 ft. apart, were sunk, and 1,200 lbs. powder placed in each to blow down the counterscarp. These were fired about a month after the commencement of the siege, but the earth thrown into the ditch was not nearly enough to fill it, and no assault could be attempted. The Russians then worked along the outside of the cofferdam, and also drove covered saps across the ditch. No. 2 Bastion was attacked similarly. Here the bed of the stream was very deep, but at length one mine of 5,000 lbs., and another of 2,000 lbs. were placed under the escarp. The quantity of powder would have been increased, but the Turks showed signs of countermining, and it was decided to hasten the explosion. No. 1 Bastion was breached on the 21st of September, and No. 2 on the 22nd. The Turks had prepared a retrenchment in rear, and an assault would have failed. It was decided to make new breaches in the curtain, but the town was surrendered on the 28th. Had the Turks known a little about countermining the Russian works would have been very much delayed.

Siege of Sebastopol.

Omitting any description of the surroundings and fortifications, the mining operations only will be touched on. Trenches had been opened on the 3rd of October, 1854, and by the 1st of November the third parallel was at 170 yards from the Flagstaff Bastion. The French commenced their galleries on the 20th, with the intention of breaching the bastion prior to an assault. Two shafts were sunk into the rock, when a bed of clay was found in which progress was rapid. It was not anticipated that the Russians had any countermines, and the first intimation of their existence was the blowing in, on the 3rd of February, 1855, of the head of the right gallery by a camouflet.

At the beginning of November the defenders thought they heard sounds of mining, and Colonel Todleben decided to organize a system of countermines. (On the 1st of January he received a plan of the French siege works which had been lithographed in Paris). His plan was to excavate an envelope gallery under the ditch of the bastion, with listeners at right angles to it. Twenty shafts were sunk into the same bed of clay which the French had discovered, but Todleben was not satisfied that his first scheme afforded sufficient protection, and relying on the motto that "the lower man has the upper hand," commenced a lower tier of galleries in a second layer of clay about 50 ft. below the surface. This lower tier comprised 480 yards of gallery, and was never used, but a mine of 9,000 lbs. of powder was discovered after the siege, at the end of one of the galleries. The lower tier had, however, a great moral value in relieving the miners in the upper galleries from the apprehension of being undermined.

Finding that they could not surprise the enemy, the French now determined to join up transversely their own principal galleries, to drive a series of galleries for mines the craters of which would intersect, to fire them simultaneously and so open a fourth parallel. After several mines had been fired on both sides the series of mines was charged by the 10th of April. There were twenty of them, varying from 1,200 to 4,200 lbs. each, up to a total of 57,000 lbs. After the explosion the

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craters were occupied and gave excellent cover, but a few mines had failed, and some craters had to be joined by sap. Owing, however, to the incessant fire and sorties of the garrison this parallel could only be occupied at night. It was connected up to the third parallel by some mine craters joined by saps. The mines which had missed fire were untamped and fired by degrees, not without casualties to the French troops.

The action of the mines had not extended far, and the Russians were soon able to repair their galleries and advance again. The French therefore practically only held the rear slope and bases of the craters. However, they were able to put listeners on a banquette on the forward slope to give notice of attempts on the Russian side to mine under the parallel, and to drive them away by mines placed in hastily excavated shafts. In other words the attackers were reduced to defensive tactics.

Meanwhile the Allies had realized that the capture of the Green Mamelon, which commanded Fort Malakoff, would entail the fall of Sebastopol. The attack on the Flagstaff Bastion thus became of secondary importance, and was only continued to occupy the attention of a portion of the garrison, and as a defensive measure, to prevent their advance under the fourth parallel. A number of fougasses were fired from that parallel, as the bastion was within range, but besides annoying the Russians they did a considerable amount of damage to the French galleries in rear.

On the 2nd of May the French had armed a battery, No. 53, against the Central Bastion and the Schwartz Redoubt which covered its left flank. In the middle of May the Russians, in expectation of a possible subterranean attack in this quarter, opened countermine galleries of similar design to those at the Flagstaff Bastion. On the 14th of August, hearing the noise of a deep sap by which the French were connecting Battery 53 with a stone quarry on its left, they fired a mine in a hurry. It did no damage to the French, and was a lucky event for them, as a few days later the Russians would have been under the battery. A subterranean war now began in front of Battery 53. Several mines were fired, but neither side gained any particular advantage.

Countermining was commenced somewhat tardily from the Malakof, on the same principles as before. Fourteen listening galleries from an envelope gallery were driven at right angles to the counterscarp, and stepped shafts in the rock led down to another tier of countermines 50 ft. beneath the glacis. By the 8th of September the upper listeners had advanced 20 to 40 ft., and four lower listeners about 17 ft. When the French obtained knowledge of these works they sank twelve shafts, from which galleries ran towards the salient of the fort. On the 6th of September, the date of the assault of the Malakof, the only three mines which there had been time to charge were fired at eight in the morning. These mines would certainly have damaged any countermines within reach, but the main object in firing them was to prove to the troops of the assault that their own miners held the mastery of the subsoil. The capture of the Malakof ended the siege. It was rendered possible only by the delay of the Russians in countermining. The latter had been preoccupied by the defence of the town, but had the countermines of the Malakof been in a more forward state, the result might have been different.

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On the French side the length of gallery and branches was about 1,200 yards in front of the Flagstaff Bastion, and 130 yards before the Schwartz Redoubt. The Russians excavated 3,000 and 2,200 yards respectively, and 550 yards in front of the Malakof. Before the Flagstaff Bastion there were 125 explosions, and before the Schwartz Redoubt 11 only. The total weight of powder consumed in mines was 115,000 lbs., as compared with 6,600,000 lbs. expended by the artillery, but of 176 casualties amongst the French miners, including 17 killed, only 4 were killed in the galleries. This must be attributed in some measure to careful listening. The Russian miners incurred 191 casualties, including 54 killed; out of these 24 were killed and 32 wounded in the galleries.

The French mines established for opening the fourth parallel were each provided with two distinct means of firing, firstly, La Rivières fuze laid on the ground, each length starting from junction boxes filled with 4½ lbs. powder, and secondly, ordinary powder hose laid in troughs and starting from the same junction boxes as the respective lengths of fuze. There were six misfires, which may have been due to the different rates of burning of the fuze and powder hose. Symmetry in the means employed for the double transmission of fire is most necessary.

Several cases of suffocation occurred in the galleries. Very thorough ventilation is necessary, and apparatus should be at hand enabling foul mines to be entered with impunity.

The Russian countermines started very regularly, but once contact with the enemy underground was established all semblance of regularity was lost. Each miner seems to have worked independently, without reference to his neighbours. The drawbacks to following no definite plan are self-evident; not only might a great deal of the work done have been saved, but it must frequently have been impossible to distinguish sounds made by the enemy from those made by a neighbour, and no large mine could be fired without damaging adjacent galleries. The lower tier of galleries was almost useless for mines. The 9,000 lbs. mine found after the siege would only have been a huge camouflet, as there were 17 yards of rock above it. This criticism does not imply that a lower tier is in no case necessary, it gives confidence to those working above, but should not be commenced, when time presses, until the upper tier has been completed.

The Russian gallery cases were frequently fixed very carelessly. This may have been due to rapidity of execution, which in mine warfare is the first condition to be fulfilled. On the other hand the tamping, which consisted of sandbags strengthened by wooden frames, was finished most minutely, interstices being often closed with rags. Voltaic batteries seem to have been used for firing the mines, and it is probable that misfires were frequent.

In front of the Carenage Battery the Russians had placed a row of boxes each containing 15 to 20 lbs. powder, and destined to be fired by a liquid escaping from a glass tube, which would be broken by the steps of the assailants. These land mines were discovered before the attack.

A.R.R.

(*To be continued*).

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FUNDAMENTALS OF MILITARY SERVICE.

By CAPT. LINCOLN C. ANDREWS, U.S. Cavalry.

The aim of this work is set out in the Dedication which reads as follows:—"To the Memory of our first President, whose profound Statesmanship demanded for the future of this Democracy that her citizens be organized and trained in arms, this book, designed to aid in that consummation, is reverently dedicated."

The scope of the publication is more fully explained by the author in his preface; he points out that, in the United States, the organic law makes military service obligatory for each male citizen between the ages of 18 and 45 years. He proceeds: "Therefore an honest performance of the duties of citizenship demands, first, that each citizen shall learn enough about the military service and its needs to give him an *intelligent opinion* thereon; and second, that each youth shall prepare himself reasonably to meet his individual responsibilities as a citizen soldier. . . ."

"This book is designed to supply the means for attaining these qualifications for citizenship, to place in one volume the fundamentals of military service, its meanings and its requirements."

It is further stated in the preface that it is intended that this work should be studied in connection with the Field Service Regulations and the Drill Regulations for the United States Army. The book has been prepared under the supervision of Major-General Leonard Wood, U.S. Army, and certain of the chapters have been contributed by officers who have made a special study of the subjects dealt with by them.

The first chapter deals with "Our Military Policy"; the opening paragraph reads:—

"The Military Policy of the United States has been expressed in its monetary motto: 'In God We Trust' and this with but scant recognition of its vital corollary, that *faith without works availeth not.*"

The author goes on to state that America, as a nation, has sedulously avoided everything military and that no attempt has been made to educate the youth of the nation, and "our millions of citizens coming from other governments," to any true appreciation of American nationalism, aspirations, true traditions and actual history. In a very brief review of the military history of the United States, he sums up the situation in the following words:—"And finally there stands our great Civil War, the glaring example of the inefficiency of our system and of its extravagant waste of life and money." "Civilian control of military matters quite beyond their comprehension" is held responsible for the "vastly inefficient and wickedly wasteful and extravagant" measures adopted with regard to the recruiting and control of the American Army in the past. It is pointed out that whether in democracies or in monarchies the requirements as regards defensive measures are to-day the same; the mobilization of vast forces is necessary. A machine so vast and so complicated, it is recognized, will take time in building, and, in consequence, the author of the work under review urges that if his countrymen hope for an army that may ever run efficiently then "skilled brains and hands had better be employed in its construction."

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The second chapter deals with the "Psychology of the Service." It is pointed out that "Military Service is our most ancient public institution. In the history of the world no free people have ever existed without it." The author proceeds:—

"Far from being a characteristic of imperialism, universal military service is the very corner stone of the edifice of Democracy; where the liberties of the people are the one aspiration of government, the people must be trained and ready to defend these liberties."

The truth contained in the foregoing extract has gradually permeated upwards and downwards through all ranks of society in this country during the past two years, and the measures recently adopted by the British Government, to ensure that adequate preparations may be made for the prosecution of the Great War we have on hand, indicate that the obligations of citizenship are at last fully recognized in our own island kingdom. There is therefore reason to hope that the British Democracy may yet continue to exist and to thrive.

The sub-sections of this chapter deal, *inter alia*, with such important matters as Subordination, Leadership, the Battlefield. The author truly says: "In battle, and in preparation for battle, there are but rare occasions for 'individual plays.' Success may be attained only through the unselfish playing for the team." It has at all times been necessary for a soldier to be an altruist; if anything, the need for this quality is greater to-day than at any other period of the world's history.

Discipline, it is pointed out, is as vital to the success of an army, as live steam to the operation of a locomotive; it represents "75 per cent. of battle efficiency." The author states: "Men and arms we may command, but money cannot buy discipline, nor munition plants supply it. It is of the very essence of training, and springs from the intelligence and conscientious work of the leaders who must inspire it, or whose incompetence will render its attainment impossible."

In dealing with the qualities for Leadership the author points out that the subject should appeal particularly to the citizen soldier, as these qualities will be of equal value to him in his civil pursuits as in his military career. Some excellent advice on this subject is contained in this chapter. The would-be leader is told that to attain the confidence and respect of his men the first requisite is *superior knowledge*, and that "A good leader is as one with his men, he speaks their language, he shares their blessings and their hardships, he is jealous of their name, he defends their sensibilities and their rights in the larger organization, in fact he is the recognized guardian of their welfare, physical and mental, as individuals and as a group."

"The psychology of control of men on the battlefield is," says the author, "a big subject, of vital importance to leaders." Man is largely controlled by his emotions; it is the task of the leader to study the mentality of the human race, in order that he may be in a position to control these emotions in critical situations. He can do so with success by training his command to meet such a situation and by setting an example in his own conduct and by showing resource when the emergency arises.

The remaining chapters of the book deal with military training,

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organization, the drill and *rôle* of the various arms of the service, tactical rules, military courtesy, guard and riot duty, musketry, map reading, care of arms, Army Regulations, patrolling, security, marches and convoys, camps and bivouacs, supply and transportation, sanitation and horsemanship. The information contained in these chapters will be found in the various manuals and books of regulations published by authority for the use of the British Army. However, those who desire to get a general bird's-eye view of military matters without spending much time in wading through the literature on the subject cannot do better than to read through the pages of the *Fundamentals of Military Service*. Among other things, it will be found that in the chapter on "Tactical Rules," the author of this work has succeeded in compressing the essential principles for handling men and situations in the presence of an enemy into the compass of three small pages. One of the most important of these principles for the young soldier to bear in mind is the following:—"If ordered to any military undertaking, never start on your mission until you have a clear understanding of each of the points you should know for its proper performance."

In the chapter on "Military Courtesy" the young soldier is informed that the observance of the forms of military courtesy is a measure of the discipline and soldierliness of an army; and in reading the pages of the little volume under review he will learn much concerning those traditions and customs of the military service which have done so much in the past to promote comradeship and a good understanding in the great profession of arms.

W. A. J. O'MEARA.

GEODETIC SURVEYING.

By EDWARD R. CAREY, C.E.—(John Wiley & Co., New York. Chapman & Hall, Ltd., London).

Geodetic Surveying is a text book on survey and is chiefly intended for those studying for the United States Survey, as frequent reference is made to the forms and methods employed in the U.S. Coast and Geodetic Survey. The book is well illustrated with diagrams and photographs depicting instruments, reference marks and beacons used in the U.S.A. It opens with a short introduction defining survey and explaining the broad principles of triangulation.

Chapter I. deals with Preliminary Reconnaissance and gives several useful tables and formulæ for use in obtaining the necessary strength of figures, heights by barometer and boiling point, and corrections for curvature and refraction. There are also a few photographs illustrating the beacons in use at several of the U.S. Coast and Geodetic Survey Trig. Points.

Base Measurement is the next subject and is contained in Chapter II., it includes the description and use of measuring bars and tapes, the

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calculations connected with base measurement, formulæ and tables for temperature, sag, grade, and tension corrections.

Chapters III., IV., V., and Appendix I. deal with the measurement of angles, the elimination of errors in angular measurements and the computations for latitudes, longitudes and azimuths, etc. These chapters also include explanations of the many types of instruments used in angular measurements.

Chapter VI. describes and explains various map projections.

Chapters VII. and VIII. deal with levelling. This subject is divided under two heads, trigonometrical leveling with a theodolite (Chapter VII.) and precise leveling with instruments of the dumpy and "Y" types (Chapter VIII.).

As each subject is taken into consideration a full description is given of the types of instruments used. Mention should be made of the fact that in Appendix II. the method of least squares is briefly discussed. The book is supplied with a good index which enables any subject to be easily referred to.

D.A.H.

ON THE MANUFACTURE AND TESTING OF PRISMATIC COMPASSES ESPECIALLY MARK VII. MILITARY PATTERN.

By F. E. Smith, A.R.C.SC.—(Reprinted from and by the *Optician and Photographic Trade Journal*).

This little book an extract from the transactions of the Optical Society is of particular interest to the manufacturer of prismatic compasses, as it discusses practically all the errors likely to be found in a prismatic compass. These errors are briefly summarized as follows :—

(1). Error due to want of parallelism of axis of magnet with the 180°–360° direction as indicated on the dial.

(2). Error due to eccentricity of dial and point of suspension.

(3). Error due to centre of suspension not being in plane containing slit and line.

(4). Error due to want of uniformity of the engraved divisions on the dial.

(5). Error due to sighting line being out of vertical when the compass is supported on a horizontal surface.

(6). Error due to prismatic effect of the glasses (window and cover).

(7). Error due to magnetic material in the case screws, etc.

(8). Error due to faulty setting of the prism in the prism box.

(9). Error due to excessive friction between pivot and jewel.

Each of the above errors is dealt with in detail and the tests described are exclusively those made at the National Physical Laboratory.

Mr. Smith points out that while his remarks are applicable to compasses in general, he deals particularly with Verner's Pattern, Mark VII. prismatic compass. The book is illustrated with diagrams and the discussion following the reading of Mr. Smith's paper is also reprinted.

D.A.H.

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NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

No. 5.—*May*, 1916.

ORDER OF BATTLE OF GERMAN ARMIES IN WESTERN THEATRE OF OPERATIONS.

The *Revue* article, which is accompanied by four sketch maps, gives the dispositions of the German Armies during the period 22nd August, 1914, to the autumn of 1915. On the first sketch map are shown the positions of the seven Armies, and of the Detachment stationed in Upper Alsace, during the Frontier Battles—22nd to 24th August, 1914—and at the Battle of the Marne, 10th September, 1914. The dispositions were as follows :—

Armies.	Composition.	Commanders.	Location. During Frontier Battles.	Location. Battle of Marne.
I.	II., III., IV. and IX. A.C. (Active Army) and III., IV. and IX. A.C. (Reserve).	von Kluck.	S.W. and S. of Brussels.	N.E. of line Compeigne - Chateau Thierry.
II.	VII. and X. A.C. (Active Army), and VII., X. and Guard A.C. (Reserve).	von Bulow.	N.W. of Namur.	E. and S.E. of Chateau Thierry.
III.	XII., XIX., XI. A.C. (Active Army) and XII. A.C. (Reserve).	von Hausen.	S. of Namur.	S. of Chalons.
IV.	VIII. and XVIII. A.C. (Active Army) and VIII. and XVIII. A.C. (Reserve).	Duke of Wurtemberg.	N.W. of Longwy.	W. of Sermaize.
V.	V., VI., XIII. and XVI. A.C. (Active Army), V. and VI. A.C. (Reserve) and 33rd Reserve Division.	Crown Prince of Germany.	E. and S.E. of Longwy.	On line Sermaize-Verdun.
VI.	XXI. A.C. (Active Army), I., II. and III. Bav. A.C. (Active Army) and I. Bav. A.C. (Reserve).	Prince Ruprecht of Bavaria.	S. of Metz and E. of Nancy.	N.E. of Nancy.
VII.	XIV. and XV. A.C. (Active Army), XIV. A.C. (Reserve) and some Ersatz formations.	von Heeringen.	N.E. of St. Die.	On line Nancy-St. Die.
Det.	Reserve and Landwehr formations.	—	N. of Mulhausen.	N.W. and W. of Mulhausen.

The only change which had taken place in the composition of the German Armies between the 24th August and 10th September was the

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transfer of the XI. A.C. (Active Army) from von Hausen's Army to the Eastern Front; this was carried out towards the end of the former month.

The second sketch map shows the positions of the German Armies on the 3rd October, 1914, in connection with the German "March to the Sea." In the interval which elapsed between the 10th September and the 3rd October considerable changes had taken place in the composition of the several German Armies and also in their relative positions in consequence of the lateral movements carried out from the left towards the right. The following statement summarizes these changes:—

Army.	Composition.	Commanders.	Location.
VI.	Cavalry, Guard and IV. A.C. (Active Army) and I. Bav. A.C. (Active Army).	Prince Ruprecht of Bavaria.	E. of Arras.
II.	I. and II. Bav. A.C., XVIII. and XXI. A.C. (Active Army) and XIV. A.C. (Reserve).	von Bulow.	On the Somme W. of Péronne.
I.	II., III. and IX. A.C. (Active Army) and IV., IX. and III. A.C. (Reserve).	von Kluck.	On both banks of the Oise, N.E. of Compeigne.
	NOTE.—There is some doubt about the last-mentioned A.C.; it may have been sent to Belgium.		
VII.	VII., X., XII. and XV. A.C. (Active Army), VII. and X. A.C. (Reserve) and a Landwehr Brigade.	von Heeringen.	N. of Rheims.
III.	VI., VIII. and XIX. A.C. (Active Army), XII., VIII. and XVIII. A.C. (Reserve) and 47th and 49th Landwehr Brigades.	von Einem in place of von Hausen.	In the Champagne, S. of Rethel.
V.	V., XIII. and XVI. A.C. (Active Army), III. Bav. A.C., V. and VI. A.C. (Reserve), 33rd Bav. Division, Ersatz and Landwehr formations.	Crown Prince of Germany.	In the Argonne and Woevre, N. and E. of Verdun.

The left wing of the Germans now consisted of Reserve, Ersatz and Landwehr formations, which occupied the positions vacated by the VII. and VI. Armies.

It will be noticed that the IV. Army was broken up, its Army Corps being transferred to the III. and New II. Armies.

The third sketch map shows the positions of the German Armies at the time of the Battle of the Yser.

A IV. Army was reconstituted previous to this battle and placed under the command of the Duke of Wurtemberg. It consisted of the III. A.C. (Reserve) taken from I. Army, 4th Ersatz Division, XXII., XXIII., XXVI. and XXVII. A.C. (Reserve).

The composition of the VI. Army had also been altered; it now consisted of the XIX., Guard, IV., VII. and XIV. A.C. (Active Army) and I. Bav. A.C. (Reserve).

The XXIV. A.C. (Reserve) had reinforced the formations in Alsace and Lorraine already in these provinces.

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The II., I., VII., III. and V. Armies remained as before except in so far as they were affected by the transfers noted above.

The positions of the German Armies were on the 24th October, 1914, as follows:—

IV. Army and Cavalry. N. of Ypres.
VI. Army. W. and S. of Lille and E. and S. of Arras.
II. Army. W. and S. of Peronne.
VII. Army. From the Oise, S. of St. Quentin to Rheims.
III. Army. S. of Rethel.
V. Army. Between the Aisne and the Meuse, N.W. of Verdun.

Det. of V. Army;—N., E. and S. of Verdun and between the Meuse and the Moselle, from S. of Verdun to N. of Nancy.

Reserve, Ersatz and Landwehr Formations;—From the Moselle, N. of Nancy to Mulhausen and Swiss Frontier.

The fourth sketch map shows the positions of the German Armies on the 31st December, 1914. Many changes had taken place meanwhile, and are shown below.—

Army.	Changes.	Location.
IV.	Decrease: III. A.C. (Reserve). Increases: Marine A.C. and 37th and 38th Landwehr Brigades.	From sea, N. of Ypres to S. of Ypres.
VI.	Decrease: 1st Div. of Guard. Increases: A Brigade of X. A.C. (Active Army). II. Bav. A.C. (Active Army), 6th Bav. Reserve Div. and 11th Landwehr Brigade.	On line Ypres to S. of Arras.
II.	Decrease: II. Bav. A.C. (Active Army). Increases: 1st Div. of Guard and 20th Landwehr Brigade.	S. of Arras to S. of Peronne.
I.	Decrease: II. A.C. (Active Army). Increases: 10th and another Landwehr Brigades.	S. Peronne to the Aisne N.W. of Rheims.
VII.	Decrease: XV. A.C. (Active Army). Increase: 25th Landwehr Brigade.	From the Aisne N.W. of Rheims to E. of Rheims.
III.	Decreases: One Division of VIII. A.C. (Active Army), XIX. A.C. (Active Army) and one Div. of XVIII. A.C. (Reserve).	E. of Rheims to r.b. of Aisne.

The detachment of V. Army under von Strantz consisting of the V. A.C. (Active Army), III. Bav. A.C. (Active Army) and one Ersatz A.C. occupied a position extending from left of III. Army on r.b. of the Aisne circling to the N. and E. of Verdun. Reserve, Ersatz and Landwehr formations carried the German left to the Swiss frontier.

The composition of the German Armies on the 9th May, 1915, on the eve of the Battle of Arras and on the 29th September, 1915, at the beginning of the Battles in the Champagne are given in the *Revue* article in tabular form and give some indication of the constant changes which have been in progress since the present trench warfare was inaugurated.

The Battles in the Champagne came to an end on the 5th October, 1915; from the 25th September to 5th October, 1915, the number of battalions on the Champagne front were increased from 70 to 108 battalions, partly by pushing reserves into the front line and partly by transferring troops from other parts of the Western Front.

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SOME OF THE PRECEPTS OF THE WAR.

"Skill will beat mere brute strength."

Redemption by Fire Effect.

"Fire effect is not everything, that's true, however without it nothing can survive, everything becomes mere cannon fodder."

It is pointed out by the author of the *Revue* article that in the earlier part of this article he has shown in what directions improvements can be effected in military training.

An extract from *Le Tir pour vaincre* is reproduced in the *Revue* article; in it the statement occurs: "Those who have heard bullets whistle past their ears, those who have been in the presence of death, those who recall that they were only able to advance or to hold on to their positions by putting their faith in the heavy pieces of their comrades of the artillery—since they had no confidence in themselves—these will guess what we are about to tell.

"Such persons are indeed convinced of the necessity which exists for a country to possess citizen-soldiers knowing well how to handle a rifle, such, for example, as the (Swiss) *tirailleur d'élite;* soldiers who are *marksmen* rather than *sharpshooters.*"

The Swiss are enjoined to seek at once to profit by the above remarks and not to wait till the bullets whistle past their ears before taking to heart the lessons contained therein. It does not require deep meditation to convince one's self that in *the superiority of its fire effect lies more than ever the secret of an army's power, and that by this factor must be measured the value of an army as a fighting force.*

This superiority the Swiss, maybe, already possess but their desire is to improve upon it. The question is asked: But how is that to be done? The reply is given in the subsequent sections of the article; all that can be said here is that when a marked improvement in their training has been brought about then will the Swiss have the right to speak of fire effect being "*the Redeemer.*" *The Redeemer,* not only by reason of its efficacy on the battlefield, but also and above all because of the feeling of confidence, of power and of invincibility with which the Swiss soldiers will then be inspired.

The Swiss people have made rifle-shooting a national sport; it is a form of sport which has a high educational value, since it develops and maintains, in the highest degree, a warlike spirit.

Warlike Spirit.

"A nation possessing a warlike spirit is mistress of its own destinies."

Major d'André has said: "One of the most important means—the simplest in every way, the most immediate, the most rapid—for developing and nourishing a warlike spirit in a nation, is the creation of a widespread taste for rifle-shooting."

This warlike spirit is of inestimable value. It is in this that resides the will to conquer, the strength to resist, in a word, the patriotism of an army and of a nation. Major d'André has defined it as the *resultant of the active moral forces; e.g.,* boldness, courage, *élan,* enthusiasm,

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initiative, etc. In order that these moral forces, which are factors indispensable for securing victory, may be efficacious, they must be *disciplined*, that is to say, completed by complementary *passive moral forces : e.g.*, discipline, devotion, self-sacrifice, endurance, tenacity, etc. Major d'André seems to consider the latter qualities, to which he has applied the term *esprit militaire*, as being antagonistic to the former, to which he applies the designation *esprit guerrier*. The writer of the *Revue* article does not concur in this view of the matter ; he takes the view that a soldier imbued solely with the *esprit guerrier* or solely with the *esprit militaire* is deficient in moral equipment.

It would seem that the French have, in recent times, been passing through an evolutionary period in this matter ; General Cherfils has recently declared the nature of the new mentality of his compatriots. He says· " Our *poilu*, our grenadier of to-day, is a hero, a *guerrier admirable :* but he is too independent ; he is not sufficiently a *soldier*, that is to say, the well-disciplined man who, bound to his neighbours by the spirit of subordination induced by the military chain of command, forms with these neighbours well-regulated and strong fighting units. The German, on the other hand, is not a *guerrier*. He is individually very inferior to the Frenchman ; but he is a *soldier*. Discipline is as the very marrow in his bones. Therein lies his power. We have somewhat lost sight of the first precept in our military catechism, which teaches that : ' In discipline lies the principal strength of armies, therefore it is necessary for every superior to obtain from his subordinates unhesitating obedience at all times.' This precept must be relearnt by us."

The writer of the *Revue* article states that happily the Swiss have not forgotten this " first precept in our military catechism." What is wanted in Switzerland are marksmen possessing battle training, *animated in the highest degree with the "esprit guerrier,"* and thoroughly impregnated with the true *esprit militaire*. Then, and only then, will Switzerland possess the *soldat complet*, the ideal combatant Major d'André has in mind. The method of forming this ideal soldier is explained in the following sub-sections.

Swiss Marksmen.

The writer of the *Revue* article is of opinion that the reproaches contained in Major d'André's book cannot, at all events, be flung at the Swiss. Much rifle practice goes on in Switzerland and it is carried out on sound lines. The brilliant results obtained at matches and the fact that numerous shooting competitions take place in Switzerland are, however, likely to create, it is thought, the false impression in the public mind that there is nothing to compare in the matter of rifle practice with what is done in Switzerland. It must be borne in mind that all Swiss soldiers are not skilled " Swiss marksmen " and that's the pity of it. The efforts made to complete the education of the marksmen in the Swiss Army have not produced the results that the authorities had a right to expect. The present war shows that new requirements have to be met by infantrymen, as well as by the other branches of the Service, and it is, therefore, incumbent on the prize-shot of peace-time competitions so to perfect his education as to become the ideal battlefield marksman so greatly in request in a modern war.

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Battlefield Marksmen.

It is a good thing for one to familiarize one's self with the realities of the battlefield of the future in order both to understand what is required of the marksman and how best he can be trained to fulfil his duties. The use of large targets for musketry practice and the practice of firing in leisurely fashion, which allows of deliberate aim being slowly taken, are conditions far from those with which the soldier is faced on service. The battlefield target consists of silhouettes difficult to discern, which appear and disappear at irregular intervals from behind a parapet with disconcerting suddenness. The skill required to place a shot with accuracy and rapidity on such a target—before the firer can himself be put out of action—is of no mean order and can only be attained as a result of great care in training. Only soldiers who possess a high degree of skill in this respect are worthy of the title of "battlefield marksmen."

Practice at targets with the ordinary bull's eyes is only the first step in the training of a marksman; this is the infancy of the art. What is wanted on the battlefield is a marksman who can hit the most difficult targets at any range, whether he is able to take deliberate aim or must fire hastily.

First Stage in the Training of the Marksman.

In Switzerland, the recruit receives his first musketry lessons from the Officer Commanding his unit and the Company Instructor; it includes a course of target practice, 100 rounds being allowed for the purpose. The allowance of ammunition is held to be insufficient; particularly in view of the fact that 50 rounds are fired as a preliminary practice in order to accustom the recruit to his rifle and to feel at ease. A total of 67 days is allowed for converting a recruit into a trained soldier; in spite of the short time allowed a large percentage of the recruits prove themselves good shots at the ordinary targets. However, it is as well to recognize that the training of the recruits in musketry is, at the end of this course, still far from being complete.

Improvement of the Marksman.

Compulsory Practice.

On the completion of the recruits' course, the young soldiers, whether they be good or bad shots, are drafted into their units. Before the present war the measures adopted in Switzerland for improving the individual marksmanship of the soldier are said to have been faulty. He fired certain courses as a recruit, but the Legislature had entrusted the task of the further instruction of Swiss soldiers in musketry and target practice to rifle clubs, a task which all clubs were not in a position suitably to carry through. It was difficult to deal with the slackers. Clubs which had the desire to fulfil their national obligations did not possess the power to give effect to their resolutions.

The Swiss military authorities recently took up the matter, and in 1914 new regulations relating to compulsory practice were promulgated. However, the mobilization of the Swiss Army which took place in 1914, brought about an interruption in the reforms then in hand.

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Mobilization and Marksmen.

Thanks to the mobilization, which has lasted for months and not days, the Swiss Army has been able to complete its higher military training and preparations for war, *inter alia*, a new rifle has been issued to the troops. In 1914, the Swiss soldier was no more than a militiaman, to-day he is a professional expert. Musketry practice has received due attention during this period, and much improvement is noticed in the marksmanship of the individual soldier, though much still requires to be done. The necessity for the introduction of measures for the *resolute adaptation of range practice to the new conditions of a modern war* still exist.

Refresher Courses.

Selection of Marksmen. Proposed Reforms.

Target practice is included in Refresher Courses and the question is how best such courses can be utilized. One suggestion is that the trained soldier should on such occasions be put through musketry training from the beginning for the following two reasons:—

(*a*). Owing to the incomplete nature of the musketry training during the recruit course.

(*b*). The necessity for the soldier to learn the technical details of his new rifle and to acquire skill in handling it with ease.

All soldiers should be made to fire an individual practice course at bull's eye targets; those proving themselves good shots should at once be passed into the First Class, for training in field practice. Those who fail to reach a suitable standard should be put into the Second Class or made to go through aiming drill, etc., again. Those who are proved to be hopeless failures at range practice should be combed out of the ranks of fighting units and turned over to non-combatant duties; they should be made to carry a stretcher, a pick and shovel, indeed any other implement except a rifle. It is no use lumbering up the infantry with *useless mouths;* men who have insufficient confidence in themselves. War is becoming more and more a *specialized calling*, let this fact be recognized and let armies be organized accordingly.

Training of Rifle Shots. Taste for Rifle Shooting.

The training in musketry is incomplete, unless it results in creating a passion for rifle-shooting, a *sine qua non* if a man is to acquire the highest degree of skill. To create this passion badges, prizes, etc., should be offered to stimulate and encourage the soldier.

The Chiefs as Rifle Shots.

"Example is the best of lessons."

Every instructor, that is to say, every officer and N.C.O., should be in a position to claim that he can turn a trained soldier into a first-class shot. However, those only who have a passion for rifle shooting and devote themselves to the pastime assiduously will be able to inspire in their pupils that taste for rifle-shooting which can alone make them into marksmen. It is thought that much is required to improve matters in this respect in Switzerland; the officers do not sufficiently show their faith in the maxim: Example is better than precept.

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Non-Commissioned Officers.

What has been said above with reference to officers applies equally to the non-commissioned officers. The non-commissioned ranks would be the first to gain by an increase in confidence on the part of the men in their superiors.

The Object to be Attained.

After completing a course of elementary target practice, the soldiers who have reached the minimum standard should next take part in individual field practices, under active conditions, at disappearing targets at unknown ranges. This second stage in the musketry training of the soldier is by far the most important and forms the most difficult part of his education. The object of this stage in his training is not only to make rifle shooting a second nature, but also to develop initiative, to foster self-confidence, to teach control of nerve-power, in a word, to put the soldier in a position to deal with any situation with which he may be faced on the battlefield.

The writer of the *Revue* article claims that he is an out-and-out partisan of the school which advocates deliberate and slow-aimed fire, but he recognizes that situations do arise which it would be dangerous to ignore; one of these is that which renders rapid fire on a battlefield an absolute necessity. There is much evidence to support this view. This being the case, there is only one satisfactory way to meet the situation and that is by so training the soldier that he will be able to deal with it effectually whenever the occasion arises. The standard fixed by Major d'André is one requiring the soldier to obtain at least three hits a minute on a disappearing figure target; he urges that a soldier should not be dismissed musketry until he has reached this standard. It is only when a man surpasses this standard that he can be considered a "battlefield marksman."

Automatic and Repeater Rifles.

"Clever soldiers do not await events, they anticipate them."

In the spring of 1915 Major d'André predicted that the soldier would shortly have an automatic rifle placed in his hands; then would begin the era of *tireurs d'élite*. Two Austrian inventors, Visni and Fuchs, are said to have invented a device which allows of the conversion of ordinary rifles into automatic rifles at a trifling cost in a very few hours. It is reported that the Germans immediately took advantage of this invention; they are said to have also adopted a Browning type of automatic rifle (discharging 10 bullets consecutively without reloading). It is rumoured that the new German regulations provide for every 25 yards of fire trench being held by two machine guns and 30 automatic rifles. The Germans are also said to be using a repeating rifle of the Danish Madsen model, weighing 16½ lbs. and capable of firing 250 rounds per minute.

The French and the British, it is stated, have also adopted repeating rifles. It is urged that Switzerland should not be blind to these developments, but should take time by the forelock. He who does not advance with the times is left hopelessly behind. No question arises, says the writer of the *Revue* article, of Switzerland attempting to compete in the

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matter of "giant artillery" with her northern and western neighbours; however, in the matter of infantry armament there is no reason why the Republic should not be ahead of her neighbours. It is urged that the crack shots of the Swiss Army should be armed with automatic and repeater rifles and so organized as to enable the best use to be made of these weapons on the battlefield. There will be opponents to this as to every new idea. Meet them, he says, by sweeping away *sacrosainte routine.*

The Swiss Rifle.

It would be a mistake, in the opinion of the writer of the *Revue* article, to arm the whole of the Swiss infantry with automatic rifles at present; it is still necessary to carry out experiments to determine the real military value of such an armament. Moreover, it is only very recently that a rifle on a new model was served out to the Swiss Army; it is an excellent piece of mechanism and in good hands will always be capable of producing excellent results. It is claimed that the new Swiss rifle and the ammunition for it are the best in the world.

Voluntary Rifle Practice and Rifle Shooting for Sport.

"Do not then, ye sons, allow your carbines to rust. Cherish them as did your forbears their halberds."

The Swiss authorities in 1915 suppressed all "compulsory rifle practices," and recently the Federal Council decided not to revive these rifle practices at all events in the current year. It has also been found necessary to prohibit the issue of ammunition to the rifle clubs; this decision of the Government has almost completely paralyzed these institutions. The consumption of munitions has been very great in the present war; so much so indeed as to cause the Powers, who have not yet been swept into the maelstrom, to be anxious to husband their resources and to increase their stocks of ammunition to meet any eventuality which may arise. This accounts for the attitude taken up towards the rifle clubs by the Swiss Government. It is urged that it would be imprudent for the Federal Council, under the pretext of effecting economics, to discourage voluntary rifle practice, one of the principal factors of Swiss national strength. The authorities are reminded that an old proverb says: Every cartridge fired in times of peace results in two being saved in time of war.

What is wanted in Switzerland is not, it is said, the suppression of voluntary rifle practice, but its reform in order to adapt it to the requirements of the battlefield. The writer of the *Revue* article says that he is an ardent believer in rifle shooting for sport; he is of opinion that even this form of rifle shooting could be taken advantage of for the purposes of training the Army.

Targets.

It is stated that the types of target now in use in Switzerland are obsolete and should be replaced as early as possible with targets suitable for field practices. It is urged that the present is an opportune moment for effecting the change, as the introduction of new types of ammunition has made the reconstruction of ranges a necessity.

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The Young Rifle Shots.

> "A people that knows how to raise the souls of its youth to meet the exigencies of war has accomplished the most important and most difficult of the tasks imposed by the requirements of national defence."

The Swiss Government has left to the initiative of the rifle clubs the important task of training the young rifle shots. The writer of the *Revue* article is of opinion that although some good results have been obtained yet much more requires to be done before the situation can be considered satisfactory; the training of the youth of the Republic for military service has, in his opinion, become an imperious necessity. The belligerents on the Swiss borders have enrolled all their young men, and mere children are in some cases filling the voids caused by the struggle in the ranks of the belligerent armies; the experiences through which these children are now passing, it is thought, will breed in them a bellicose spirit, an excess of Chauvinism. Thus it becomes necessary that the present generation of Swiss children should be brought up in such a manner as to be in a position to face the worst that may come. It is recommended that, *inter alia*, courses of rifle practice should be specially organized for Swiss lads and attendance thereat should be made compulsory for all young fellows between 16 and 20 years of age.

Conclusion.

The writer of the *Revue* article feels that there are many who will oppose his views. Nothing, he says, will give him greater pleasure than to see the matters discussed by him thoroughly ventilated in the public press. He recalls the incident in the French Chamber just prior to the Franco-German War of 1870 when Marshal Niel was introducing his scheme of Army Reform. A deputy rudely interrupted the Marshal with the question: "Do you wish then to convert France into immense barracks?" "Take care," retorted the old soldier gravely, "that it is not turned into a graveyard." Those who are hostile to the development of the Swiss Army are asked to meditate upon these words.

A Few Notes on Musketry Instruction.

It is pointed out in the *Revue* article that the whole world had for some time past fully realized that the advances which had been made in the technical matters connected with armies would profoundly modify the character of war as known to older generations. The Powers have in recent years been ready to adopt the smallest improvements in arms or military stores and equipment promising any advantage however small. For example, Switzerland has spent hundreds of thousands of pounds for the purpose of obtaining a firearm with a flatter trajectory and providing greater penetrative power than that possessed by other Powers. Recently, a new weapon has been placed in the hands of the Swiss soldier which, when fired from a rest, is capable of planting every shot, aimed at a target at 300 yards range, into an area less than the size of a man's hand. However, the standard of skill demanded from a soldier is such that six consecutive shots fired by him at a range of 300 yards will obtain hits on a target such that their average distance from the centre of the bull's eye does not exceed 19½ in.

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This standard shows a marked disproportion between the accuracy of which the weapon is capable and the skill required from those who handle it. The opinion is expressed that the standard fixed is not high enough.

It is urged that it should be impressed on recruits from the beginning of their instruction that what is required from them is "fire intended to kill" and not "fire intended to frighten" the enemy. For aiming drill a figure having, as viewed from the firer's position, the apparent size of a man's head at a range of 300 yards should be used as a target. It is important that in the early stages of musketry training all efforts should be directed to secure that a recruit shoots correctly for elevation; at first, it is not so important to consider the question of accuracy for direction. The latter point can be attended to later, when the recruit has mastered the difficulty of holding his rifle properly so as never to miss placing his shots between two horizontal lines at the desired vertical distance apart.

The writer of the *Revue* article suggests that the method of classification now in use in connection with the musketry training of the Swiss Army requires to be completely changed. "Cones" of fire should never, in his opinion, be referred to in the presence of soldiers, who should not be encouraged to contemplate the use of collective fire; they should alone be concerned with the result produced by each individual shot fired.

The principal faults made by bad shots in using their rifles are the same the world over, viz., aiming with either too full or too fine a sight, holding the rifle with sights inclined out of the vertical, and jerking at the trigger; of these the last mentioned is the one most difficult to cure. It is suggested that the recruit may be cured of this fault if he can be made to press the butt of his rifle well into the shoulder in the manner prescribed by the regulations, a matter which is rarely attended to.

INFORMATION.

Switzerland.—An extract from Army Orders published on the 22nd April, 1916, authorizing the Swiss troops to fire on foriegn aircraft on receiving orders to do so either from an officer or an N.C.O. is given in the *Revue*.

A copy of an order issued by the Adjutant-General on the 28th April, 1916, relating to the presence of travelling photographers in barracks and camps is reproduced. Attention is drawn to the fact that some of these itinerants are undesirables and should be excluded from camps, etc.

The death is announced of Lieut.-Colonel Paul Guignard.

W. A. J. O'MEARA.

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WITH

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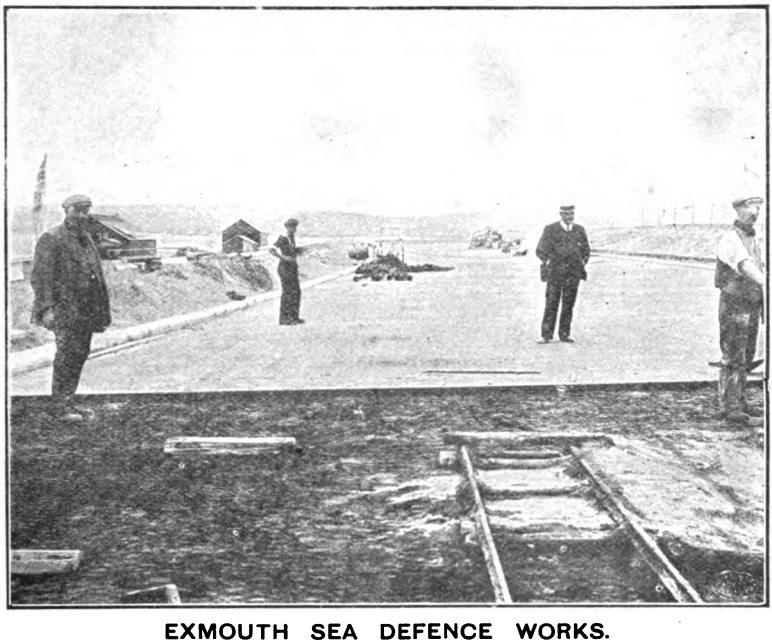

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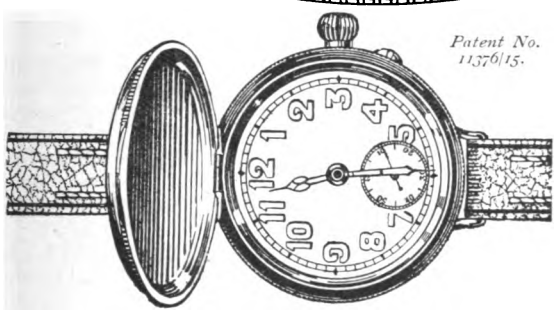

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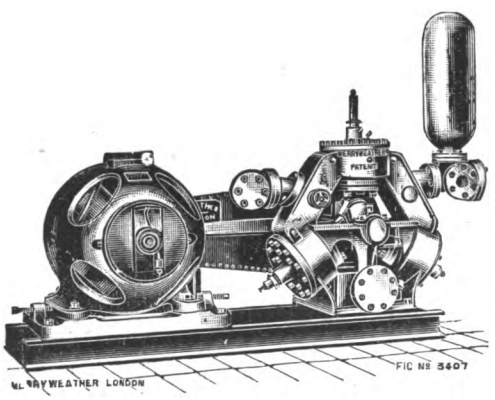

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TEMPORARY GIRDER BRIDGES.

THE tables A and D published in the July number of the *R.E. Journal* are cancelled, having been prepared last September for panel point loading only. Corrected tables given below have been kindly furnished by the writer of the article, Major O. G. Brandon.

TABLE A.—GIRDER BRIDGES TO CARRY SINGLE ROADWAY FOR HEAVY MOTOR LORRIES.

I.e. up to 17,700 *lbs. on back axle and* 7,100 *lbs. on front axle and crowded* (10 *ft. between back axle of one lorry and front axle of next lorry*).

Span. Feet.	No. of Girders.	Bays.			Booms.			Verticals.			Diagonals.				Bolts for Boom Joints.		Alternative to Diagonals.		
											Centre.		End.					Per Bay of each Boom.	
		Number.	Length. Feet.	Depth. Feet.	Maxm. Area. Square Inches.	No. of 9″ × 3″ in Centre.	No. of 9″ × 3″ at End.	Maxm. Area. Square Inches.	No. of 9″ × 3″ in Centre.	No. of 9″ × 3″ at End.	Area. Square Inches.	Diam. of Bar. Square Inches.	Area. Square Inches.	Diam. of Bar. Square Inches.	No. each Side of Joint.	Diameter. Inches.	*Web Planking each Side. Ins.	¾″ Bolts or 6″ Nails.	
10	2	4	2 6	2 6	33	2	2	15	1	2	·4	¾	·8	7/8	4	¾	¾	7	70⁴″
20	2	4	5	5	61	2	2	22	1	2	·6	7/8	1·2	1 3/8	5	¾	1½	15	100⁴″
30	2	6	5	5	78	3	3	38	1	2	·9	1⅛	2·2	1¾	10	1	¾	17	180⁴″
40	2	8	5	5	94	4	3	44	1	2	1	1¼	2·7	2	10	¾	1	15	88
50	2	10	5	5	125	4	3	59	1	3	1·2	1⅜	4	2¼	11	¾	1¼	16	120
60	4	10	6	6	74	3	2	32	1	2	·4	¾	2·3	1¾	10	¾	½	20	66
80	4	12	6 8	6	110	4	2	40	1	2	·9	1⅛	3	2	9	1	¾	18	80
100	6	14	7 2	7	91	4	2	40	1	2	·8	1	2·2	1¾	8	1	½	20	80

REMARKS.—The roadway may be carried on either top or bottom booms, but the former is preferable as it is easier to arrange the roadway. If necessary to have the latter arrangement, 9″ × 3″ cross-bearers should be placed about 3 ins. apart and the roadway laid on top of these and parallel to the bridge: special care must be taken to ensure that the cross-bearers rest evenly on all the girders.

* If web planking is used (instead of iron diagonals) of the thickness shown, the planks must touch each other at the abutments: in the centre third bays they may be spread their own width apart as "A" in sketch (see July *R.E. Journal*).

* If planking double the thickness shown is available this may be placed its own width apart at the abutments, and double its width apart in the centre third bays, as "B" in sketch (see July *R.E. Journal*).

If it is desired to make the verticals of iron and the diagonals of timber, the direction of the diagonals must be changed so as to slope UPWARDS towards the centre of the bridge: the sizes of material required in this case can be ascertained from the table as follows:—

$\frac{1}{10}$ × area of wood vertical in table = area of iron vertical (which is now in tension).

12 × area of iron diagonal in table = area of wood diagonal (which is now in compression).

N. B.—This method of conversion can *not* be applied to replace wood by iron unless the direction of the diagonal is changed.

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TABLE D.—METHOD OF CALCULATION.	13 | 10 | 13 7100 7100 17700 17700 EXAMPLE WORKED OUT FOR 40 FT. GIRDER LOADED AS ABOVE.
Total live load $= W$	... ... $2 \times 17700 = 35400$ $2 \times 7100 = 14200$ 49600
Equivalent dead load $= 2W$	 99200
Allow "n" panels of depth "d" ft. and breadth "b" ft.	Allow 8 panels of depth 5 ft. and breadth 5 ft.
Dead load per panel $= \frac{1}{n} \times 2W = w$	.. .. $\frac{1}{8} \times 99200 = 12400$
Weight of panel $= p$	800
Total weight on each panel $= w + p$	 13200
Boom.—Let "r" be the number of any member in which it is required to find the stress.	To find the stress in top boom panel No. 4.
$T_r \times d = -(w+p)\, b \left\{ \frac{r}{n}[1+2+\ldots\ldots\ldots+(n-1)] - [1+2+\ldots\ldots\ldots+(r-1)] \right\}$	$T_4 \times 5 = -13200 \times 5 \left\{ \frac{4}{8}[1+2+\ldots+7] - [3+2+1] \right\}$
$T_r = A$	$T_4 = -13200 \left\{ \frac{1}{2} \times 28 - 6 \right\} = 105600$ lbs.
Allow F. of S. $= 5$. Safe stress in fir $= 1200$ lbs. per sq. in.	
Area required $= \frac{A}{1200} = C$ sq. ins.	... ... $\frac{105600}{1200} = 88$ sq. ins.
Allow for Y girders.	Allow for two girders.
Area of boom for each girder $= \frac{C}{Y}$ sq. ins.	... ... $\frac{88}{2} = 44$ sq. ins.
Local Bending Moment.	
$W_1 =$ weight on any bay $= \frac{2 \times \text{Axle Load}}{Y} = \frac{2w_1}{Y}$	
As end of girders are fixed and weight partially distributed,	
M_t may be taken $= \frac{W_1 l}{12}$	Axle load $= 17700$.
$\frac{1}{6} rbd^2 = M_t = \frac{W_1 l}{12}$	
Assume $d = 9$ ins.	
$bd = \frac{W_1 l}{12} \times \frac{6}{1200 \times 9} = \frac{2w_1 b \times 12 \times 6}{Y \times 12 \times 1200 \times 9} = \frac{w_1 b}{900 Y} = \frac{E}{Y}$ ...	$bd = \frac{17700 \times 5}{900 \times 2} = \frac{98}{2}$.
Total area of boom for each girder $= \frac{C}{Y} + \frac{E}{Y}$ sq. ins.	$= \frac{88}{2} + \frac{98}{2} = 93$ sq. ins.
I.e. B pieces of 9 ins. × 3 ins.	*I.e.* 4 pieces of 9 ins. × 3 ins.

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METHOD OF CALCULATION—*cont.*	EXAMPLE WORKED OUT FOR 40 FT.—*cont.* GIRDER LOADED AS ABOVE—*cont.*
Bolts for Boom.—Stress on bolts $= A \times \frac{1}{Y} \times \frac{1}{B}$ ...	... ... $105600 \times \frac{1}{2} \times \frac{1}{2}$
A "t" diam. bolt through 3-in. timber takes stress $= t \times 3 \times 1200 = t \times 3600$	A $\frac{3}{4}$-in. bolt takes stress $= \frac{3}{4} \times 3 \times 1200$.
Number of bolts $= \frac{A}{Y \times B \times t \times 3600}$	... ... $\frac{105600}{2 \times 2 \times \frac{3}{4} \times 3600}$
	I.e. 10 bolts on each side.
Verticals.—Total load $= n \times (w + p)$	... ... 8×13200
R_1 at abutment of each girder $= \frac{n \times (w+p)}{2 \times Y} = K$	$\frac{8 \times 13200}{2 \times 2} = 26400$
Since "d" lies usually between $\frac{1}{12} \times L$ and $\frac{1}{24} \times L$ safe stress in fir $= 600$ lbs. per sq. in.	
Area of vertical at abutment $= \frac{K}{600}$ sq. ins.	... ... $\frac{26400}{600}$ 44 sq. ins.
I.e. S pieces 9 ins. × 3 ins.	*I.e.* 2 pieces 9 ins. × 3 ins.
Diagonals.—Load on panel of each girder $= \frac{w+p}{Y}$ ...	... ... $\frac{13200}{2}$
Now $V_r = \frac{(w+p)}{n}\{1 + 2 + \ldots\ldots\ldots (n - r + 1)\}$ $- \frac{p}{n}\{(r-2) + (r-1) + \ldots\ldots\ldots + 1\}$	$V_2 = \frac{13200}{8}\{1 + 2 + \ldots\ldots\ldots + 7\}$ $- \frac{800}{8}\{0\} = 23100.$
Now $D_r = V_{r+1} \operatorname{cosec} \theta$.	$D_1 = V_2 \operatorname{cosec} 45^\circ = V_2\sqrt{2}$ $= 23100 \times 1{\cdot}41 = 32571.$
Since safe stress in W iron $= 12000$ lbs. per sq. in.	
Area of diagonal $= \frac{D_r}{12000} = \frac{V_{r+1} \operatorname{cosec} \theta}{12000}$	... ... $\frac{32571}{12000} = 2{\cdot}7$ sq. ins.
Web Planking.—Average resistance of fir to shear $= 300$ lbs. per sq. in.	Available depth $= 60$ ins. $- 10$ ins. (approx. depth of boom) $= 50$ ins. say.
Thickness "f."—Then "f" × available depth of girder $\times 300 = R_1 = K$.	$f \times 50 \times 300 = 26400.$
	$f = 1\frac{2}{3}$ ins. *I.e.* 1-in. planking on *each* side.

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METHOD OF CALCULATION—*cont.*	EXAMPLE WORKED OUT FOR 40 FT.—*cont.* GIRDER LOADED AS ABOVE—*cont.*
Bolts.—Resistance of fir = 1200 lbs. per sq. in. Hence number of bolts × diameter × f × 1200 = K.	Take $\frac{3}{4}$-in. bolts. Number × $\frac{3}{4}$ in. × (2 × 1) × 1200 = 26400. Number = 15.
Nails.—Assume a 6-in. nail has a holding power of 300 lbs. Number $= \frac{K}{300}$.	$\frac{26400}{300} = 88$.

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THE JUNCTION OF THE INDIAN AND RUSSIAN TRIANGULATION WORK IN THE PAMIRS.

[FROM THE RECORDS OF THE SURVEY OF INDIA.]

(*Continued*).

THE LINK BETWEEN THE CHAPURSAN AND THE KILIK PASS.

By C. S. McINNES, *Extra Assistant Superintendent, Survey of India.*

By the end of the 1912 season, an approximate series had been carried from Hunza northwards as far as Khodabad Village in the Hunza Valley, and a reconnaissance had also been effected from the Russian stations on either side of the Beyik Pass to the Kilik Pass. It remained to reconnoitre the country between Khodabad and the Kilik.

Khodabad is situated at the junction of the Kilik River, flowing from the pass of that name, approximately from north to south, and the Chapursān River, which flows from the Afghan border on the west. This latter is the main branch of the Hunza River. During the previous season it had been found impracticable to carry the series by the direct route *viâ* Murkushi and the Kilik Valley to the Kilik Pass, and it had been decided to try and force a connection westwards up the Chapursān and then to strike northwards across the mountains and join up with the Kilik stations.

I shall here give a very brief description of the lower Chapursān, between Khodabad and Spinje, which was the only portion of this valley over which we worked. On leaving the former place, one enters a valley more open and less striking than the Hunza Gorge, and it is pleasing to find that instead of steep pathways hung on galleries and pegs driven into the cliffs, a comparatively smooth and level track over which ponies can travel, is met with. Sixteen miles from Khodabad there is a small jungle of willows, which is known by the name of Spandrinj; the whole of these sixteen miles are extremely barren, and almost unbearable in the summer months owing to the heat. Between Spandrinj and Spinje, a distance of some 15 miles, there are two small villages, Kil and Reshit, the only two in the whole valley. The combined population only amounts to 35 inhabitants. On either side of the river the banks are thickly clothed with willows, but the hillsides on either hand are bare to the last degree throughout the entire length of the valley. The height of the River at Reshit is about 10,000 ft. and the mountains on both sides rise to a height of some 20,000 ft., the ascent being gradual for the lower portions, after which the mountains become precipitous and rocky.

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In order to carry out the reconnaissance, a detachment was formed in Hunza, consisting of the writer, Goharayah Havildar of the Hunza levies, six Garhwali khalassies, who were to carry instruments, and who had been enlisted in Dehra Dun, and one levy who was in charge of fifty permanent coolies enlisted in Hunza. Besides this permanent establishment, a hundred extra temporary coolies were engaged to carry rations as far as Khodabad, which had been decided on as our depôt during the season. All arrangements were completed by the 25th May, and early the next morning my whole detachment left Hunza for the first march up the valley, and arrived at Khodabad five days later.

On the 1st June I made my first ascent to a peak due west of Khodabad, accompanied by the havildar and a local guide obtained in the village, and after deciding on the first figure with which to extend the series, we returned to Khodabad. On our way back we came across the tracks of a snow leopard on the snow, and further down the hill we found the remains of a large ibex, which had evidently been killed the previous night. On the following day I set out for a peak on the Kilik-Chapursān watershed, due north of Khodabad, and sent my camp to the foot of the peak. After a very fatiguing climb, mostly over shale, and lasting eight hours, I arrived at the summit and made a station, after which I returned to camp. The following day the detachment marched to Spandrinj, and from here on two consecutive days, I visited the two peaks called Spandrinj Sar and Sumayar Sar, situated above the right and left banks of the river respectively; on both these hills stations were built, their heights being 15,640 and 17,249 feet respectively. We started for Sumayar Sar at 6 a.m., and after fording the Chapursān River ascended the Kermin Pass and, continuing westwards along the ridge, reached the peak at about 2 p.m., after having been climbing for five hours over snow in a bitterly cold wind. I may here remark that the high winds for which the Pamirs are noted, terminate at the ridge above the left bank of the Chapursān.

We had been very curious to see what the country north of the valley was like, and from Sumayar Sar we had an extensive view of this land of peaks, which lay between us and the Kilik Pass. The scene was anything but reassuring. We saw numerous peaks ranging to over 18,000 and 19,000 ft., and shaped like a series of pinnacles. The more rounded and lower ones were under a thick layer of permanent snow, and the approaches to these seemed to be blocked by much-crevassed glaciers which appeared to render them inaccessible. Below us flowed the Derdi, a large stream which enters the Kilik River above Misgar, and the sides of the mountains above and beyond the Derdi looked inaccessible in most places. We returned to camp below the station at 8 p.m. and on the following day made a short march to Reshit, from which place I ascended on the 9th June a peak south of the village, built a station and returned.

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The weather which had up till now been brilliant, suddenly changed, and we awoke on the morning of the 10th to find that it was raining heavily, and all the hills round hidden by low clouds. This spell of vile weather lasted for nine days, with brief intervals of fine weather which continued for a few hours, and which I utilized by attempting to climb a peak north of Reshit, but without any success. On the 19th, however, the weather at last cleared, and accompanied by Goharayah, the levy and several coolies, I set out determined to fix my last station in the Chapursān Valley before rain came on again, of which there appeared every prospect. For the first 1,500 ft. the climb was simple, and there was only a little snow on the ground, but beyond this the ascent became stiffer, for about 2 ft. of new snow had fallen. The wind had risen considerably, so that we had to climb from this point in a cloud of snow dust. The coolies, too, began to complain, although the heaviest load was only a plane table, and after every 500 yards an argument ensued between the havildar and levy on one side and the coolies on the other. However, chiefly owing to the firmness of the two former, we arrived at the summit of the station, known as Reshitipūr Sar, height 17,734 ft., after a climb lasting 10 hours, and everyone was as miserable as they could be. Fortunately the site was suitable for a station, and we returned to camp at 8 p.m. thoroughly exhausted, after experiencing one of the worst days of the whole season.

The Chapursān stations were now complete, and the next three days were spent in marching to the Derdi, to a point below Sumayar Sar on the north. We had now reached the country that had looked so formidable, and in reality it turned out to be as difficult as it had appeared on first impressions. All the nalas are piled with heaps of rocks which have fallen from the neighbouring hillsides, and almost continuously throughout the day one hears the sound of falling boulders, which reverberates and re-echoes for miles round. These falling stones are a constant source of danger, as the hills are so precipitous that one cannot step aside to avoid a stone, and on one occasion in particular we very narrowly escaped. I had climbed halfway up a peak with a dozen coolies, and we had reached the foot of a waterfall about 30 ft. high, when a huge boulder struck the head of the fall and bounded a few yards over our heads, and two coolies were badly cut by splinters.

In order to save time I had sent the havildar, on whom I could depend, with some coolies to see whether certain peaks were climbable, while I tried to get up other peaks. For three days neither of us came across an accessible peak, but on the fourth I managed to ascend to a point, known as Lupjangal Sar, from which I thought the Kilik stations were just visible, but later, when helios were used, it was discovered that this point could not be seen from either of the Kilik stations, and I had to return to this part again.

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Some idea of the difficulty of the country may be formed from the fact that of eight peaks which were attempted, only one was climbed to the summit, and as stated above, this turned out to be of no value. I had next to fix a station above the Derdi, north of Reshitipur Sar, but after my recent experiences, I did not think that there was any likelihood of my being able to ascend from the Derdi, and I decided to try from the north. Accordingly, I marched round *viâ* the Kilik Valley to the Hark stream which flows from west to east and enters the Kilik at a spot known as Bun-i-kotal, about 5 miles south of the Kilik Pass. Our efforts on the following two days, the 29th and the 30th June, proved that the summit of the ridge was inaccessible beyond doubt from the Hark stream, owing to the numerous hanging glaciers, cut up by crevasses which lay between us and the summit. We had no alternative now but to return to the Derdi and attempt an ascent from the south, and before returning I moved the two Kilik stations south of the pass.

On the evening of the 1st July, Lieut. Mason and Capt. Hingston arrived at the Kilik Pass with a mixed crowd of Sarikōlis, Gurkhas, Hunzakūts, Kashmiris, Baltis and Garhwalis, and I went over to their camp the next day and discussed the work with Lieut. Mason, after which I returned to my camp at Bun-i-kotal in the evening. The day had been cloudy and windy, and snow fell during the night. My thermometers showed a minimum temperature of 35 degrees for the day, and a minimum of 16 degrees for the night. These were the lowest temperatures registered by my thermometers during the season.

On the morning of the 3rd July I commenced marching to the Derdi stream and five days later camped near the snout of a glacier at its source. During the next week I reconnoitred every day for a suitable site for a station, and at length I managed to climb to a high peak, called Tong-i-tuk, which proved satisfactory. Tong-i-tuk is the highest station of the entire series, being 19,135 ft. above sea level. Before returning to the Utwashk nala below Lupjangal Sar, I intended to observe to the surrounding stations from Tong-i-tuk, and I moved to the peak with a very light camp consisting of three light tents. I expected to finish the work in a day and a half, but owing to the signallers at Kilik East station not being sufficiently wideawake, I was forced to spend five days at the station, during which we had several falls of snow and the coolies had to live on very short rations.

Having completed the observations here, I returned to the Utwashk nala, where I spent five of the most strenuous days of my life, during which I was away from the camp and reconnoitring for an accessible peak on an average of 12 hours a day. When I did eventually climb to the summit of a peak called Murkushi Sar and fix a station there, I had been out from 5 a.m. and did not

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get back to my camp till 9 p.m. I should never have been able to reach the summit of this peak, of which the height was 18,322 ft., had it not been for my Hunza coolies, who are famous for their mountaineering accomplishments, and who assisted me over the more precipitous portions of the ascent. All the stations were now selected, and at last on the 3rd August the completion of the link with the Russian triangulation hove in sight. The observations in this portion were simple compared with the fatigue of constantly climbing and searching for feasible mountains, even though I had to observe under unfavourable conditions. The signals I had to observe to were mostly bell-tents, and the khalassies whom Collins had sent to place these signals at my stations had pitched them with the white side of the cloth outermost, instead of the blue side as they had been instructed. The result was that it was only with the utmost difficulty that I could identify even the nearer signals, while those further away were quite invisible. The stations, too, were all placed on rocky knife-edged ridges, so that it was impossible to make the theodolite stand correctly and truly rigid, while the space round the instrument was so limited that I had to move round by stepping over the legs of the stand. The weather, too, was very unsettled and the signals were constantly obscured by mist. This appears to me to be the reason why the error rose in this section of the work for a short distance.

I finished work at Murkushi Sar on the 5th August, and as I had only to take observations to this point from Tong-i-tuk, I took only a few coolies lightly laden to this latter peak, sending the main portion of my camp to the Chapursān. I arrived at a spot below the peak on the 7th August, and made preparations to ascend the station, finish the remaining work and return to the valley during the next day, but on the following morning we found ourselves in a dense driving mist, while snow was falling. This bad weather lasted for five days without a break, but on the sixth it cleared, and after a desperate effort we climbed to the station, knowing that a few more snowy days would render the peak absolutely impossible. I finished the observations and returned to camp the same evening.

The remaining portion of the work had to be somewhat rushed through as the season was by now far advanced. The recent five days' snow saved me from the necessity of marching round by Khodabad into the Chapursān Valley, as the Derdi stream was now fordable, and I could cross into the Chapursān Valley *viâ* the Kermin Pass. I commenced work on the Chapursān stations on the 15th August, and completed my last station on the 22nd, just in time to avoid a spell of bad weather which set in the following morning and which continued beyond the 5th September, which was the date of my departure from Hunza on the return journey to Kashmir.

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SOME GEOGRAPHICAL IMPRESSIONS OF THE PAMIRS AND THE NORTHERN KARAKORAM MOUNTAINS.

By LIEUT. (NOW CAPTAIN) K. MASON, R.E., *Assistant Superintendent, Survey of India.*

Perhaps it is wrong to get geographical impressions of a district. But when one is dealing with a complicated puzzle like the Pamirs, it is so difficult to be certain of anything, that practically the only way to set about unravelling the puzzle is to let impressions strike one on the spot and then try and find proof or otherwise. To illustrate the initial difficulty one has only to quote the following passage :—

"Humboldt's conception of the Pamir was a great meridional range connecting the Tibetan and Thian Shan systems, and this view was supported subsequently by Hayward; but Severtsoff and Fedchenko contended that the fundamental mass of the Pamir Plateau was a series of parallel ranges running from east to west. From the plains of Kashgar, Hayward saw a snowy range on the east of the Pamir running north and south. Fedchenko argued that this so-called range consisted only of the ends of the parallel ranges which were running east and west." *

When opinion is so divided as to the *direction* of ranges one is inclined to hesitate with an impression.

Undoubtedly the range that Hayward saw from the plains of Kashgar, was what is now generally known to geographers as the "Kashgar Range," and on Stolickza's authority, this range is a continuation of the Kuen Lun. This Kashgar Range is a higher one than the Sarikōl, which rises behind it and which Hayward therefore could not see. Severtsoff and Fedchenko were more acquainted with the Russian Pamirs, which consist of high glacial valleys, running approximately east and west, and connected on the east with the Sarikōl Range.

We did not have the opportunity of visiting the Great or Little Pamirs, and so our impressions of these have been largely borrowed from the Report on the Proceedings of the Pamir Boundary Commission, 1896, and we started out with the idea that the Sarikōl or Kashgar Ranges were the eastern boundary of the Pamir mass and that the former somehow or other joined up with Sir Francis Younghusband's Aghil Range.† Owing to the decided advantage of high trigonometrical stations, we hoped to be able to get a continuous series of points on this supposed continuation of the Sarikōl Range to show at any rate some present-day range connection with the Aghil. We were met by a difficulty almost at once. All the main spurs and mountains are so much the same height that it was extremely hard to recognize the same point from different stations,

* Burrard and Hayden: *Geography and Geology of the Himalaya Mountains and Tibet*, page 68. † *Op. Cit.*, page 69.

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and to separate in one's mind the different spurs from ranges. And one's first impression was of a gigantic game of noughts and crosses or of a jig-saw puzzle upset in the toy department of the Army and Navy Stores.

Gradually, however, impressions began to grow, and the first point one became aware of was the apparent termination of the Sarikōl Range on the northern side of the Taghdumbash. There appeared to be no continuation or connection on the southern side. From the Russian station of Sarblock, and from our high station of Tomtek we could see the so-called Sarikōl Range trending more or less northwards, but there appeared to be no continuation to the south. From Takhtakhūn hill station and from Tomtek we could see far to the south the main Karakoram Range in all its snowy beauty, and much nearer and a good deal lower there appeared due south of Takhtakhūn another range, less grand and imposing, since it seemed lost in the magnificence of the vast waves of this sea of mountain splendour. This appeared as a line of snow-capped peaks, with depressions between them; but still it seemed to us undoubtedly a distinct range, whose highest slopes and peaks were clothed with eternal snow. This range seemed to trend roughly east and west, but how far in the former direction we were unable to estimate, as the view in that direction was cut out by a series of peaks and spurs of about the same height as our station of observation. The photographic survey has since indicated that these peaks lie on a snow-covered range of which the highest points are between 19,000 and 21,000 ft.

It seemed to us then that this southern boundary range of the Pamir Plateau was the possible extension of the Northern Hindu Kush on the west, and later in the season we saw what we assumed to be the latter range approaching the country south of the Kilik Pass, and from our stations on each side of this pass we tried to follow a connection between the two. The country between the Kilik and the Chapursān is a mass of granite peaks; there is a high peak, $\left(\frac{\text{Pk. 31}}{\text{42 K}}\right)$, south-east of the Kilik Pass, and south of the Mintaka there is a huge dome-shaped peak over 21,000 ft. in height, $\left(\frac{\text{Pk. 57}}{\text{42 L}}\right)$. Between Misgar and the Kilik and Mintaka Passes practically the whole structure is granite, excepting some striking recent river terraces between Misgar and Murkushi. It appeared to us that there had been an original connection between the range we had seen from Takhtakhūn h.s., and the Northern Hindu Kush, and that this connection used to run south of the present watershed. It seems, too, that this idea would be caused by the forces of denudation at work. Assuming that the Taghdumbash Pamir was at a comparatively recent date covered with a glacial cap, the lower depth to which the Hunza River has cut its bed to the south would

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give the latter great power to cut its course back into the dividing range, which would be practically protected by its ice-covering on the northern side. The glaciers on this side would have no chance of equalizing matters and of keeping the watershed true to its axis. This seems to have been the case, and it seems that the connection between the ranges mentioned above extended to a point about 5 miles east of the Mintaka Pass, and then practically followed the present watershed, and possibly joined on to the Aghil Range.

In connection with this southern alignment, we again had an opportunity of observing the neighbourhood of the Mintaka Pass on our return journey. During our march up the Mintaka River on the Pamir side, we came on many erratic boulders of granite which could never have been brought down by the present river, and it seems doubtful whether any Pamir *river* could have transported them. They could not have fallen from the neighbouring hills, which are composed of shales and slates, and therefore they must have been derived from the old Northern Karakoram Range. On leaving the Mintaka River, opposite the snout of the Mintaka Glacier, which may be taken as the present source, one ascends a moraine which appears to be a terminal one, formed by the retreating Mintaka Glacier when it reached the bend and changed its direction from south-east to north. At the top of this moraine near the dâk hut, appear a series of what seem to be the lateral moraines of a glacier which originally came from the direction of the pass. Large granite boulders appear in this moraine, but the formation on either side is still shale. These glaciated granite boulders continue to the summit of the pass, which is now much covered by granite blocks which appear to have fallen from the granite cliffs above, which now line the summit of the pass on either side. These cliffs are extremely steep and the pass is very narrow. From near the top of the pass on looking up the Mintaka Glacier, the crest of the watershed at its head seems to run back in a south-westerly direction, and to join on to the main lines of higher granite peaks, south of the Gulquāja Glacier, which is one of the sources of the Hunza River; it looks as though the present watershed between the Mintaka and the Gulquāja Glaciers is only a spur from this original range, and that the latter glacier originally drained through the gorge which is now the Mintaka Pass. This pass has been formed by the retreat of the Gulquāja Glacier and the closing of its outlet to the north by the granite débris fallen from the cliff walls. Certainly the Gulquāja Glacier must have been at some higher level than it now is; but it seems that this is the only solution that will account for the polished nature of the granite and the high lateral moraines near the top of the pass, which could never have been formed by any diminutive glacier descending from the present pass. This glacier must have been the Gulquāja; the forces at work in these regions are colossal, and one has only to watch the Hunza

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River in autumn with its thick pea-soup-like whirl of waters to realize where the cutting power comes from. When the old outlet became choked, the river had a tremendous task before it, but it is probable that by this time the Hunza River had nearly cut its way back and captured the waters of the Gulquāja. The present watershed, as mentioned above, has still on its northern side a covering of shales, while this rock is not met with on the south till below Misgar, and though there is little now in the alignment of ridges and spurs that can be designated by the term *range*, which denotes length and continuity, the high granite peaks south of the passes, one of them rising to over 21,000 ft., seem to confirm the original axis of continuous elevation.

It is perhaps more difficult to trace the width of this range than its continuity, and it now appears more in the nature of a big step on to the Pamir mass. But the fact that the slates on the north of the passes dip approximately to the south-west, at a very high angle, may mean that the original fold was in the form of an inverted anticline to the north-east. It may be a solution that the Sarikōl Range is a long southerly extension of the Trans-Alai or Thian Shan and that with the "rucking up" of the mountains, the crust has become highly compressed in the angle between the Sarikōl and the Trans-Alai. If this were so, it would be natural to assume the crust as "bunded up" against this angle and one would expect the long parallel systems of drainage running from east to west, which is a feature of Pamir topography.

A possible extension of this idea might account for the Kashgar Range to the east. Suppose the Pamir crust to be exerting its pressure against the Sarikōl-Trans-Alai angle, a pressure in the Sarikōl crust from the west would be induced, and this would stand as a buttress in the way of advancing waves of crust from the north or north-east. The Kashgar Range would be the result. There is some evidence that the Sarikōl is older than the Kashgar in the fact that the Tashkurghān River has kept its channel open through a gorge in the Kashgar Range, during the elevation of the latter.*

Appearance of a Portion of the Karakoram Range from the North.

Only a small length, comparatively speaking, of the Karakoram or Hindu Kush Range could be seen at one time from any one station on the Pamir, and this portion lay in the extension of the Karakoram Range, west of the Hunza Gorge. Perhaps the best station of observation was Kilik East h.s., though we seldom had a day clear from haze or clouds from here.

The easternmost point triangulated on this range was $\frac{\text{Pk. 33}}{42\ \text{L}}$. This appears from the north as a large detached peak, the highest

* *Manual of the Geology of India*, 1st Edition, 676 (1879).

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thousand feet or so being scarred with rock precipice too steep for much snow to rest upon. Two main arêtes are visible and these meet at a right angle at the summit of the peak and appear to carry slopes of névé on the southern faces. A smaller northern arête abuts the scarred northern face but does not reach the summit. The eastern arête appears to throw out a long buttress toward the north some 3,000 ft. from the top.

Between this peak and $\frac{\text{Pk. } 55}{42\text{ L}}$ there is a marked depression. $\frac{\text{Pk. } 55}{42\text{ L}}$ appears from the north to be a snow pyramid situated on an extensive field of névé, which is almost level, but has a slight gradient upwards to the south-west, where it appears to culminate in a massive dome of eternal snow, which is probably higher than $\frac{\text{Pk. } 55}{42\text{ L}}$, but which offered no point for triangulation. The névé field finishes abruptly on the northern side in an extensive icefall, from which the range appears to fall steeply into the Batūra Glacier valley.

To the west of this dome, the range is depressed to a saddle and then rises and forms a huge massif for which I could as usual obtain no name. The whole was covered with a glittering icecap and presented very few outcrops of rock for many thousands of feet, and contained few points suitable for triangulation. $\frac{\text{Pk. } 32}{42\text{ L}}$, 25,540 ft., is on this massif and appeared approximately the highest point, but there were several rounded domes of snow, some nearer some further off, which made distinction impossible. I considered it advisable to make certain of what appeared to be approximately the highest point of this massif, rather than confuse at so great a distance the work with useless observations.

$\frac{\text{Pk. } 31}{42\text{ L}}$ lies some 2 miles north-west of $\frac{\text{Pk. } 32}{42\text{ L}}$ but was not re-observed, and west-north-west of this another peak, $\frac{\text{Pk. } 48}{42\text{ L}}$, was observed by Mr. McInnes.

$\frac{\text{Pk. } 24}{42\text{ L}}$ is still further to the west and is a true peak, with an outline somewhat similar to Rakaposhi, except that it presented a series of alternate rock arêtes and snow couloirs. This peak could be likened to a head placed on two fairly symmetrical shoulders, the latter being represented by two long sloping arêtes, east and west respectively.

This line of peaks $\frac{\text{Pks. } 24,\ 25,\ 48,\ 31,\ 32,\ 55,\ 33,\ 34,\ 35,\ 67}{42\text{ L}}$ indicates the axis of the Hindu Kush or westerly extension of the Karakoram Range, for a distance of some 35 miles.

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SCIENCE AND INDUSTRY.

THE value, and indeed the necessity, of research work as a factor in industrial progress is now becoming generally recognized in this country. This recognition has been somewhat tardy, but it is none the less gratifying, and its ultimate effect cannot fail to be far-reaching.

Especially is research work of importance in connection with our vast engineering industries. It is therefore of great interest that the North East Coast Institution of Engineers and Shipbuilders has recently appointed a Research Committee, and that the latter has already made a start with its work by acceding to the request of a well-known firm in the north to investigate and carry out exhaustive tests of apparatus having for its object the more economical production of power by marine steam engines. By its action it will be the first of the influential technical institutions actively to promote the progress of the industries with which its members are associated by officially making and recording tests of new apparatus developed by them.

A fresh and most valuable field has thus been opened up, and the Institution may also have inaugurated the commencement of a new era in the history of similar institutions—an era in which the application of science to all branches of industry will be immensely extended. For instance, in the introduction and development of improved apparatus much depends on an authoritative pronouncement concerning the results claimed, and this can best be secured through the verdict of independent bodies who are not influenced by commercial considerations.

These bodies already exist in the shape of institutions such as the North East Coast Institution of Engineers and Shipbuilders, and, as the result of their findings would be at the disposal of all, a spirit of industrial co-operation would be engendered that would not only be to the advantage of the industry immediately concerned but for the good of the nation as a whole. Furthermore, an ever-increasing mass of important data would be accumulated, representing the collective knowledge of each industry, and from the publication of this data would result the incidental but highly important effect that much overlapping of experimental work would be avoided. Lack of such data causes experimental work to be undertaken by individual manufacturers in ignorance of, and without opportunity for, ascertaining what has been done in the past

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on precisely the same lines. This, of course, involves unnecessary and heavy expenditure and as a consequence, experiments which do not appear to promise any definite result are too often broken off before an ultimate conclusion is reached. It is quite conceivable that in many such cases new discoveries—together with the practicable applications of which such discoveries are susceptible—are missed by us and rediscovered later by our competitors abroad.

It may be stated that the necessity for the establishment of some measure of ordered and systematic research has recently been recognized by the manufacturers in certain trades. Previous to the War both the Institution of Mechanical Engineers and the Institution of Electrical Engineers gave official recognition to the value of research organization by appointing research committees. It was not, however, until war had broken out and we had unpleasant proofs of the dependence upon foreign research of many of our industries—the chemical industry for example—that definite action was taken to meet the demand for closer co-operation between science and manufacture. A notable sequel was the appointment by the Government, in July, 1915, of a Scientific and Industrial Research Committee. Little is as yet known of the actual work carried out during the year by this Committee. It may be that the work will prove of national value, but the existence of such a committee by no means closes the door to research work such as that which has been so promisingly begun by the North East Coast Institution of Engineers and Shipbuilders. Increased efficiency in production is now generally recognized to be the essential factor if the many and complex industrial problems that will inevitably present themselves after the War are to be coped with successfully. The decision of the Institution will certainly prove of the utmost assistance in achieving this end, and is particularly noteworthy in that it is the first practical step towards the joint effort by science and industry to reach a desired goal.

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SOCIETY OF ENGINEERS.

Visits to Engineering Works.

We are informed that the Society of Engineers is experiencing considerable difficulty this year in arranging its usual visits to engineering works during the summer. Recently, however, Messrs. Johnson & Phillips were able to show them a portion of their works at Charlton, including a large plant for the manufacture of telephone cables capable of dealing with cables up to 1,000 pairs of small wires for local lines, and also "trunk" cables consisting of fewer but heavier wires.

One shop contained a large number of multiple-headed machines for covering the single wires with one or two layers of paper put on longitudinally or spirally, and forming a more or less loose tube of paper, also a number of special high-speed twinning machines which are used to twist two of the covered conductors together forming the "twin" which is wound on to a larger bobbin. These bobbins are taken to the "laying-up" machines—in another shop. Several of the "laying-up" machines are arranged for laying-up pair telephone cables of which large quantities are made.

Other larger machines consisting of three or four sections, each carrying different numbers of bobbins, are designed to "lay-up" the twinned conductors into cables, each layer of conductors being stranded in opposite directions. These machines will deal with cables up to 150 pairs. If the cable has to be made up with a larger number of pairs, it then goes to a still larger machine having four or five sections, the largest of which carries 70 standard bobbins, or, if necessary, 100 or more narrower bobbins.

The cable can be built up in this machine with several more layers of conductors put on in opposite directions, until it reaches a total of 800 to 1,000 pairs, according to requirements. The cable so made is coiled on to steel drums which are then placed in large steam-heated hermetically sealed chambers, to dry the paper covering, the moisture being carried off by means of an air pump which causes a more or less perfect vacuum in the chamber.

When the cable is thoroughly dried it is taken to the lead-covering press, and coated with lead. These presses consist of a lead container having a point or core and die through which the cable to be covered passes. Two hydraulic rams are arranged to work into

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the lead container, and operated on the lead. Above the container is the lead-melting pot, the molten lead being run from the pot into the container where it is allowed a few minutes to "set" and then the hydraulic pressure is applied. The point or core through which the cable passes is cone-shaped, so that when the pressure is applied the lead moves forward off the core and through the die, this being the only exit, and the point of the core being close to the die a tube of lead is formed of such size as to cover the cable, take a grip of it, and pull it through the press as the pipe is formed.

The cable so covered is coiled on to drums and tested under water —with the ends of the pipe and cable projecting, to see that the pipe is quite sound and watertight.

These lead-covering presses can deal with cables of any practical length, without any joint in the lead pipe, because when a charge has as far as practicable been extruded, the hydraulic ram is withdrawn, and a further charge of molten lead is run into the container, and automatically burns itself on to the block of lead which is left in the chamber and around the cable.

In the same department there were a number of stranding machines of various sizes for dealing with copper strands composed of different sizes and numbers of wires as used for cables for power transmission and lighting, also a number of paper insulating machines for covering the strands with varying numbers of layers of paper according to the thickness of insulation required. These machines each have four or five heads, each head having three arms, and each arm adapted to carry three discs of paper, enabling the machines to put on 36 to 45 layers of paper at one operation. The heads of these machines have hollow mandrils through which the cable passes, while the head revolves laying the strips of paper on the cable spirally. From these machines the cable is coiled into steam-heated hermetically sealed pans, all moisture being evaporated and drawn off by means of an air pump. A resinous compound is admitted into the pan while it is still under vacuum, and the dry paper readily takes up the compound, and in a short time becomes thoroughly saturated. When this condition is reached, the vacuum is broken, the pan opened and the cable is passed through the lead-covering press as before described in connection with the telephone cables.

After lead covering, the power and lighting cables are usually armoured with steel wires or steel tapes, and protected with preservative tapes or jute yarns and compounds. The wire armouring machine is practically the same as the large stranding machine, arranged to carry a large number of bobbins: it sometimes being necessary to use as many as 100 or more wires.

The steel taping machine has a very massive head provided with

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two worm adjusted quadrants, each of which carry a disc of steel tape. The head has a hollow mandril through which the cable passes, and the head revolving lays the tapes on the cable helically. Each tape is laid on in an " open " helix, the tapes being adjusted so that the outer one covers the space between the coils of the inner tape, so as to provide a perfect shield. Over the steel tapes it is usual to put one or two tapes or layers of jute and compound, and this is done at the same time as the armouring.

In the rubber cable department were seen wires and cables of various sizes being covered with pure and compounded rubbers, afterwards vulcanized and protected by tapes, braiding, etc. Especially interesting were the longitudinal rubber covering machines which are arranged to cover 12 conductors simultaneously with two, three or four layers of rubber. In these machines the wires are made to pass side by side through grooved rollers, while strips of rubber are fed in with the wires—one above, and one below—the rollers, crushing the rubber strip together between the wires, and practically forming a band of 12 covered wires, with a fine fin of rubber between them.

The crushing of the rubber has the effect of uniting the two strips of rubber at the side of each wire, and the fin is so thin that the band easily splits up, leaving 12 separate covered wires, which are coiled on to separate drums.

These rubber-covered conductors are then wound on to steel cylinders and placed in steam-heated pans in which they are submitted to a certain temperature for a certain period, according to the size of the wire or cable, and to the quality of the rubber being dealt with. After this operation the cable is protected with tapes or braiding and preservative compound according to specification.

For making the smaller strands Messrs. Johnson & Phillips, Ltd., have installed many of their latest high-speed stranding machines, which run at speeds of 1,250 to 1,000 revolutions per minute. These are comparatively long machines, with bobbin carriages arranged in a long cage ; tandem to one another, and supported in ball bearings, in such a manner that they remain stationary while the cage revolves around them. The cages are splendidly balanced and they are supported at intervals in their length on special rollers which ensure very quiet running.

In addition to the stranding and covering machines, there were also various machines for cutting the rolls of rubber and cloth into strips to suit the various sizes of conductors.

The majority of the rubber-covered cables when completed are tested under water, and the visitors saw several large testing tanks and special testing rooms engaged upon this work.

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Practically all the machines used by Messrs. Johnson & Phillips, Ltd., in their cable-making department are of their own manufacture, this work being a speciality of theirs. Owing to the short time at the disposal of the members, we were unable to go through various other shops engaged in the manufacture of transformers, switchboards, and switch gear: instruments, arc lamps, etc., but we spent a short time in the general engineering shop which is usually engaged in the manufacture of all kinds of cable-making machinery and of cable picking-up and paying-out gears and equipments for submarine cable steamers, but which this time was engaged on various munitions work.

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REVIEW.

HISTORY OF UNDERGROUND WARFARE.

Being a Review of the book by A. GENEZ, Captain of Engineers, French Army.—(Librarie Militaire Berger Levrault, Paris, Rue Des Beaux-Arts 5–7, 1914. Price 5 francs).

(*Concluded*).

SIEGE OF TU-YEN-KWAN, *23rd November*, 1884, *to 3rd March*, 1885.

During the Tonkinese War 600 men held Tu-yen-kwan against a Chinese army. The latter fired 10,000 shells and 1,000,000 cartridges, opened 5 miles of trenches, excavated 10 galleries, and fired 7 mines. Improvements to the defences and countermine works were all directed by Serjt. Bobillot, of the Engineers, to whose zeal, intelligence and initiative the success of the defence was in a great measure due. The defenders had no powder for mines, all they could do was to try to penetrate the enemy's galleries, and if not successful in doing so, at any rate their countermine galleries might constitute a species of safety valves, and dissipate harmlessly to some extent the effect of the enemy's explosions. The little garrison held out long enough to enable a column to arrive to relieve them.

SIEGE OF PORT ARTHUR, *May*, 1904—*January*, 1905.

Omitting all general description of the country, fortifications, and strengths of the rival armies, the progress of the underground warfare only will be followed. The most important works were those undertaken against three of the detached forts, North Ki-kwan, East Erh-lung and Song-shu-shan. The Russians were driven within their main line of defence on the 28th of July, 1904. Between the 19th and 25th of August the Japanese Army, under General Nogi, attempted an *attaque brusquée*, and gained a little ground, but it was evident that regular siege works would have to be undertaken.

North Ki-kwan Fort is pentagonal in shape, its front facing north-east. The parapets of the face and flanks were 10½ ft. above the terreplein and 24½ ft. thick. The ditches were not revetted, and were about 13½ ft. deep and 25 ft. wide. The flank ditches were enfiladed from casemates built opposite the front face in the counterscarp, which was indented for that purpose. The walls and roofs of these casemates were of concrete 3 ft. thick. Communication with the interior of the fort was by a counterscarp gallery sloping downwards along the right flank as far as the gorge, and then by a passage under the ditch. At the time of the siege these galleries were incomplete. Double-storeyed barracks with ditches closed the gorge faces, and the gorge ditch to the left was

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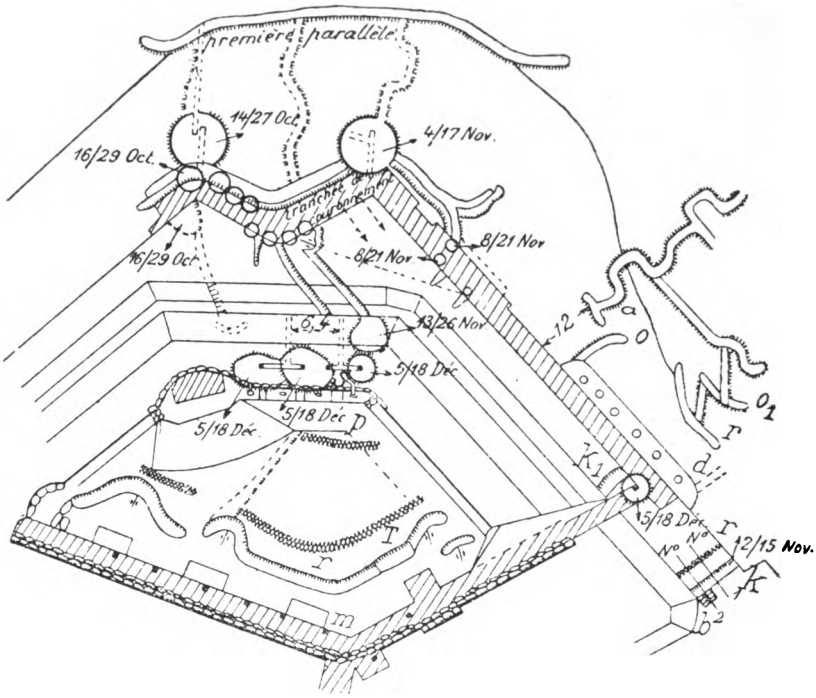
flanked by a caponier. Sandbag parapets were erected on the barrack roof. There was a bridge over the gorge ditch which was under fire from the Japanese position.



Works of Attack and Defence of Fort No. II.

At each flank of the casemates in the salient two arches had been left, from which countermine galleries were to have been driven, but these had not been commenced. By the middle of September the Japanese saps were not far from the fort, and it appeared that further progress was being made by mining. On the 14th countermining was begun by parties of 16 men with 8-hour reliefs; the Sappers were untrained in mining, most of the picks and shovels had been lost in the advanced positions (Nan-shan, etc.) and those bought locally were of very inferior quality. Later on a few tools of extreme lightness and strength were captured from the Japanese, indeed they were the object of several sorties. In the left-hand gallery work proceeded rapidly, in the right-hand gallery rock had to be removed with hammer and chisel.

As nothing definite was known of the Japanese mines, a sortie was organized on the 15th of October. The troops were armed with rifles, hand grenades and torpedoes of guncotton in tin cylinders, the last intended for blowing up the Japanese mine shafts. The sortie failed, and a similar attempt next day met with as little success, countermining proceeded therefore very much by guess work. On the 16th the left gallery was about 17 ft. long when the crater of a Japanese shell was broken into. As no plans of the fort were available, the gallery had

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been driven too close to the surface of the glacis. The opening was closed and a shaft sunk a yard further back to 13-ft. depth, whence the gallery was continued towards the front. Part of the shaft was cased in, the remainder was not revetted. On the 17th accessory defences were prepared by fixing fraises on the berms, wire entanglements in the ditches, and fougasses and planks studded with nails on the glacis. Every fougasse to be fired electrically was abortive; the conductors had been laid on the ground, and were all sooner or later cut by shells.

On the 20th of October a fairly successful sortie took place, and it was ascertained that the Japanese had two galleries, one directed towards the centre of the front face, and another towards the left salient. This was, as a matter of fact, wrong, there was only one gallery; it would appear that the reports of soldiers were relied upon, and that no officer had been specially detailed to verify the information. On the 23rd from the left gallery the Japanese miners were heard, on the 24th the Japanese stopped work when the Russians did so, and *vice versâ*. It was evident that each knew of the other's presence. On 25th two more shafts were sunk in the floor of the casemates, whence fresh galleries could be driven if required. On the 26th it was estimated that the Japanese were only 5 ft. away, to the left of and slightly above the Russians. Lieut.-Colonel Rachevski, of the Engineers, calculated at 210 lbs. the charge for what was intended to be a camouflet, with L.L.R. of 21 ft., and coefficient for loamy soil, but Colonel Grigorenko, the Chief Engineer, using the higher coefficient for rock, decided to use 285 lbs. There was no powder nor means of ignition in the fort, and an officer of the *fougassiers* was sent for to bring the necessary materials. At 8 p.m. the Governor, Lieut.-General Smirnov, arrived, gave orders to charge the mine, and expressed a wish to fire it himself. Five detonators were placed in the charge, the conductors were 5-stranded and lead sheathed, and were taken from the mine in two groups in case of accident. A man watched a galvanometer during the charging and tamping to make sure of the electrical continuity of the circuit. A man was placed in the gallery to work with a pick, and deceive the Japanese as to what was really going on. Air spaces seem to have been left in the tamping. The mine was fired at mid-day on the 27th of October, and two officers standing in the casemates close to the entrance to the gallery heard no noise at all. Mr. David James, an English correspondent with the Japanese, relates that a squad of six of the Engineers of the guard worked till the last endeavouring to reach the Russian mine and remove the powder. Three were afterwards taken out badly wounded, the other three must have been killed. The explosion destroyed a large portion of the Japanese gallery, at the same time the ground was so disintegrated that the latter were able next day quickly to drive a sap up to the concrete wall of the casemates. Another report states that a corner of the building was actually exposed at the rear edge of the crater.

On the 28th the Japanese blew a large hole in the corner of the casemate, the explosion extinguishing the lights in the rooms. Miners' candles were distributed and lighted, rifles posted to prevent the Japanese entry, and attempts were made to block the hole with sandbags. A sandbag parapet was erected in the next room opposite the communi-

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cating archway. The Japanese now blew up the sandbags in the hole they had made, and leaping in, drove the Russians behind their parapet, and placed a machine gun opposite it. Hand grenades were thrown, and the air became so vitiated that the candles were again extinguished. A Russian grenade set fire to some explosives brought by the Japanese, partially wrecking the casemates, and driving the Russians back to the further rooms. Colonel Rachewski now arrived, order was restored, and the Japanese driven out. After some time an officer of the Russian Engineers and a soldier managed to slide into the ditch, and blew in a loophole of the casemate on the left of the Japanese sap, entered the room, and secured themselves with sandbags. Grenades thrown through the hole, and a hot fire from the ramparts, checked all further approaches of the Japanese, on the other hand neither could the Russians break out.

The Russians now placed explosives in the walls separating the rooms of the casemates in their rear, for use in case they were driven back. They were arranged to be fired electrically from the counterscarp gallery. Meanwhile their right gallery had advanced about 35 ft., and a charge of 575 lbs. powder was placed in it. On the night of the 30th of October the Japanese breached the roofs of the remaining three rooms of the left half of the block of casemates, and drove the Russians into the right half. The Russians were thus no longer able to enfilade the ditch of the left flank of the fort. A party of Japanese tried to escalade the escarp, but were driven back.

On the 31st Japanese assaulted the right half of the casemates; the countermine prepared in the right gallery was fired and they retired. At 7 and 9 p.m. general assaults were made and repulsed.

On the 2nd of November the Japanese drove a sap round the back of their half of the casemates, and, entering the ditch by holes made in the front wall, managed to secure themselves on the exterior slope of the front face. In order to make sure of hitting them in this position the Russians had to tie grenades to cords, or their missiles rolled harmlessly into the ditch. The Japanese made wire screens to catch them, and could not be dislodged, indeed they had commenced a mine gallery in the exterior slope. The Russians placed a *cheval de frise* in front of the site of the expected explosion.

By the 9th of November the Russians had been driven out of three of the five rooms in the right half of the casemates, and the Japanese had pushed a mine gallery along the outside towards the right. On the 10th the Russians fired a second countermine from their right gallery. The tamping was insufficient, and smoke and flames were forced back into the casemate, but the Japanese gallery seems to have been damaged. On the 14th a third countermine was fired, of guncotton this time, as there was so little space for tamping. Some Japanese must have been cut off in their trenches by this explosion; they presently sent five carrier pigeons out to convey news of their predicament.

The Japanese were still heard at work outside the casemates, and on the 17th a fourth mine was fired from the right-hand gallery. It was at first intended to fire 70 lbs. guncotton, but this charge was doubled in the hope of securing a greater effect. The result was disastrous for the Russians. The back wall of the casemates was shattered, and the

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opening into the countermine gallery was exposed. The Japanese then attacked, but were driven off. A traverse was built opposite the opening, and a sort of fougasse was prepared and fired, but its only effect was to knock down the traverse. The latter could not be restored, and the Russians withdrew from the last casemate into the counterscarp gallery. The fight for the casemate had lasted six weeks, and for the next month a desperate struggle underground was to follow for possession of the gallery.

On the 19th of November the Japanese placed a 3-in. gun in the casemates, and destroyed the gorge caponier, but this gun was shortly put out of action by fire from the Little Eagle's Nest Battery. Three other guns consecutively met with the same fate. The Japanese then tried pumping an irrespirable gas into the counterscarp gallery, but this was remedied by making another opening, and operating a diver's pump to increase the ventilation.

On the 21st of November the Japanese boldly entered the ditch and blew in the wall of the counterscarp gallery behind the Russians, and fired through the opening with a 2-in. gun which they had brought into action in the ditch, behind the parapet of the covered way they had built leading to their gallery under the escarp of the front face. The Russians retired behind the next breastwork which they had erected, and a third breastwork was constructed further in rear. The Japanese also sapped along the back of the gallery wall, and blew another hole opposite that made from the ditch. The arched roof was blown in, and more asphyxiating gas pumped in, probably obtained by burning guncotton or melinite. The hole in the roof could not be closed for fear of suffocation.

The Japanese now made a traversed approach from the Kouropatkin Redoubt, which they had captured in September, towards the middle of the gallery, where the wall had not yet been covered with earth. They were within 50 ft. when the Russians began a counter-approach from the back of the wall. Fortunately a Russian sortie from the Kouropatkin Lunette succeeded in partly destroying the Japanese trenches.

Work on the gallery under the parapet had been pushed on actively, and on the afternoon of the 26th of November, after a tremendous cannonade from the siege batteries, the Japanese exploded two mines on the front face near the right salient, and assaulted the fort. A hand-to-hand fight ensued, and the Japanese were ultimately repulsed. At 1 p.m. Colonel Aoki himself rushed on to the parapet with the flag of his regiment, but the attack he led was also repulsed with great loss. The Japanese, however, held on to the mine craters and were only driven from them after nightfall. This was part of a general assault on all the works, in which the Japanese lost 12,000 men.

A calm followed, and the opportunity was seized by the Russians to construct a retrenchment in the fort, opposite the expected breach, and place in it two guns and two machine guns. The Japanese also recommenced their work on the exterior slope in spite of the grenades thrown by the garrison. They also repaired their sap opposite the right flank. While collecting their wounded the Russians took note of two Japanese mine galleries under the parapet on a level with the berm

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near the right salient, and another near the left. The retrenchment was strengthened with wire entanglement.

On the 4th of December the Russians unsuccessfully attempted to demolish, during a sortie, the Japanese approach on the right flank. They placed automatic fougasses in the hollow behind the wall of the counterscarp gallery, which besides causing loss to the enemy, would serve to warn the Little Eagle's Nest Battery that the fort was being attacked. Shots were still being exchanged daily in the counterscarp gallery.

On the 9th of December the Russians began to drive a gallery from the counterscarp gallery towards the Japanese saps on that flank. By the 13th the hourly expectation of explosions under the front parapet had reduced the garrison to an indescribable state of nervous tension. To counteract this two Boules' shafts were sunk in the terreplein for countermines, and a listening gallery in the parapet was loaded as a mine. On the 15th the Japanese threw some lighted arsenical compound into the counterscarp gallery to smoke out the Russians. Some hours later General Kondratenko and Colonel Rachevski were killed in the fort by the bursting of a 28-cm. shell. In the death of the latter the defence experienced a severe loss.

Up to the 17th of December there was great indecision about charging the Boules' shafts in the fort. Capt. Schwartz, of the Engineers, wished to charge them, his arguments being firstly, that a Russian explosion would cause no panic in the fort, and would forestall the enemy, and secondly, that if the latter overheard the Russians tamping they would promptly fire their mines, but the garrison would be prepared for such an event, and would not be caught unprepared. General Foch would give no decided answer, so von Schwartz referred to General Gorbatovski, who consulted the Chief Engineer. A council was convened and it was decided to charge the shafts on the 18th. This was too late.

On the 18th at 10 a.m. the Japanese opened a heavy fire on the fort. At about 1.30 p.m. three successive explosions took place in the front face of the fort, and the intensity of the fire was increased. As soon as order was restored guns and machine guns were cleared of the earth which covered them. A Japanese assault after the first explosion had been repulsed, a second assault after the second explosion was overwhelmed by the third explosion, which appears to have been premature. At 3 p.m. Colonel Aoki's regiment held the forward edge of the craters. Only 20 Russians in the fort remained fit for duty, and a counter-attack delivered by them failed. Reinforcements arrived, but their efforts were in vain; the Japanese erected a breastwork of sandbags on the edge of the craters, and placed machine guns behind it. By evening all the guns in the fort had been dismounted, and at 11 p.m. the garrison evacuated the fort, bearing with them wounded, ammunition, breech blocks, machine guns and provisions. The guns had to be abandoned, as the gorge bridge had been broken down. When the tail of the column was 100 yards from the fort the barracks were blown up with the explosives already placed in readiness in the walls.

Numerous comments have already been made on the folly of building counterscarp galleries exposed to a mine attack without adequate countermine protection. From the point of view of fortification it is

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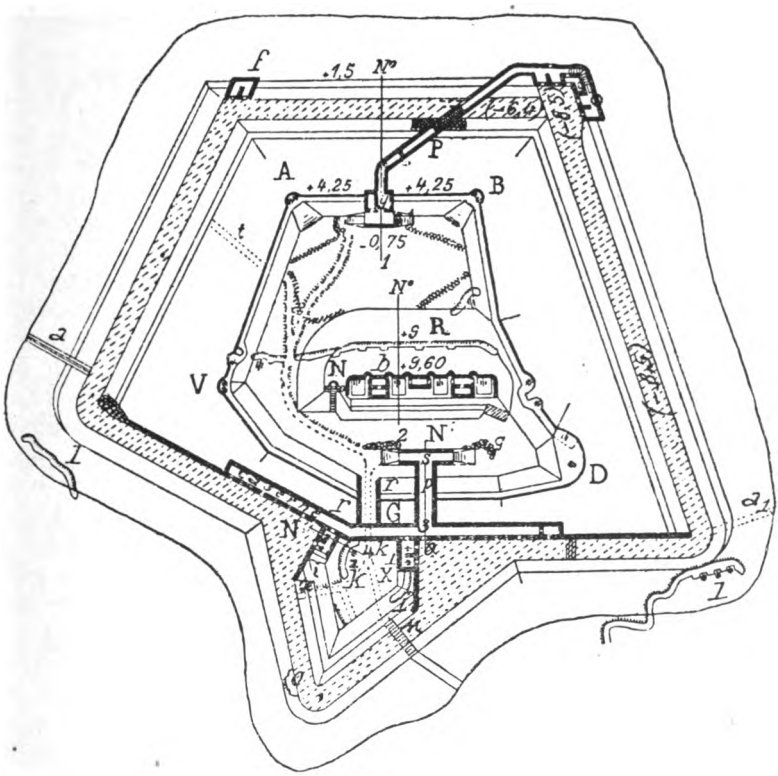
interesting to note the efficient flanking defence afforded to the right flank of North Ki-kwan by the Little Eagle's Nest Battery. Doubtless the Great Eagle's Nest had as efficiently enfiladed the left flank, certainly the Japanese made no advance against that flank although they were in possession of the left end of the salient casemate at the end of October.

As regards the mine defence it seems evident that the Russians were unskilled in this nature of work. It was commenced too late, and the anxiety displayed over the arrangements for the first mine shows that it was considered no ordinary matter. Russian tenacity prevented the Japanese from immediately profiting by their capture of the left end of the casemates, but it is surprising that no attempt was made to countermine the Japanese advance under the front parapet. It cannot be argued that the enemy's fire prevented any work in the fort, since the Russians were able to build a retrenchment, and place obstacles there. In this particular instance borings would have been of immense service, but the Russians had no apparatus.

East Erh-lung Fort was situated on a spur of the Dragon Range. It and Fort Song-shu-shan mutually supported each other. The work consisted of a front and two flank faces with a curved gorge. At the outbreak of the war the ditches, cut in the rock, the concrete case-



Plan of Fort No. III.—Scale 1 : 2000.

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mates at the forward angles of the counterscarp, and the concrete barracks closing the gorge, were just completed; the parapets had not been built and work was at once put in hand. Those of the front and flanks consisted of the natural rock with 2 to 3 ft. of earth over it. The gorge parapet was on the roof of the barracks, revetted with cement barrels and sandbags. Sandbag loopholes were made on all faces, the front face was also traversed. The left flank was exposed to view and reverse fire from Ta-ku-shan, and in August the banquette was widened, and a parados provided. The right flank was enfiladed from Wolf's Hill, and was given traverses and overhead cover of wooden beams covered with earth.

The terreplein was bare rock, and was covered with 1 ft. of earth. In the centre was a battery for four 6-in. guns, and an observatory tower. Officers' quarters, kitchens, magazines and latrines were all improvised. The front ditch was 21 ft. deep, and 28 ft. wide, the flank ditches sloped up to the gorge, the scarps were all vertical. In the right salient of the counterscarp was an L-shaped block of casemates for enfilade fire along the front and right flank ditches, a smaller casemate in the left salient flanked the left flank ditch. The former was reached by a passage under the ditch leading from the centre of the front face, the inner end of this passage was defended by a guard room. No gallery had yet been built to the casemate in the left salient, this casemate was therefore only approachable from the ditch and was consequently isolated. At the foot of the glacis was a wire entanglement.

It was only when the Russians found their counterscarp casemates threatened by the Japanese that they began to countermine. They first dug a trench in the glacis to defend the right casemate, and placed under it in shafts three mines of 70 lbs. of powder each. On the 26th of October when forced to abandon this trench they blew it up. Two openings were then made in the back wall of the right casemate whence it was intended to drive countermine galleries 30 ft. long, to join them by an envelope gallery, and excavate mine galleries from that. There were only seven sappers available, and hardly any tools for rock cutting, so that work was very slow. On the 28th a sortie was made to try to damage the saps constructed by the Japanese from the trench which had been abandoned and blown up, and which the Japanese had repaired and occupied. Another sortie was made next night, both were unsuccessful. On the 29th the Japanese were heard working behind the right casemate wall, and at 4.30 a.m. next day they blew a hole in it about 7 ft. in diameter and rushed in. The Russians retired by the passage leaving behind two 37-mm. guns and two machine guns. The passage was then blocked with sandbags and boxes of earth at a point under the parapet. The Japanese wrecked the casemate, and demolished part of the front wall. A general assault was made that day; the columns reached the crest of the glacis, and brought scaling ladders and light footbridges, but these were all too short for the deep and wide ditches. Fire from the fort and adjacent works dispersed the attack. The left casemate had been cut off all day, and that night its garrison fell back into the fort. No countermining had taken place on that side. Although the Japanese advance had been by sap only, yet in a

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week's time they had won to the counterscarp; it had been very different at North Ki-kwan where the countermines, although commenced very late, delayed the attackers for three weeks.

The Russians now built two walls of stone in cement to block the passage under the front face; the first, close behind the barricade they had made, was solid except for a listening hole, the second, some yards further back had an opening at the top to throw grenades through, a shuttered loophole, and a manhole at the bottom.

By the 10th of November the Japanese had completed the works with which they crowned the glacis. On that day they blew up the casemate of the left salient, and made preparations to drive a mine gallery under the front ditch. They also attempted to bridge the ditch from the right casemate till a hot fire caused them to cease. On the 17th further attempts were made to demolish the right casemate, but the front wall was only cracked.

On the 18th more sappers were sent to the fort, and placed three charges each of 55 lbs. of melinite under the foundations of the passage guard room, so that it could be blown up if captured. Under the parapet of the left flank, and on the banquette, fougasses, each of 50 lbs. guncotton, were prepared, the electric conductors were buried 18 in. and the ends taken to the barrack. On the 19th, two countermine galleries were commenced, one from the right wall of the passage, between the two stone walls, the second from the banquette of the front face on the left of the passage. The reinforcement of sappers was now withdrawn, and those in the fort only continued the work half-heartedly.

On the 20th the Japanese blew down the counterscarp of the front face in three places, and threw a quantity of faggots into the ditch. Three companies tried an assault which failed. From the 22nd to the 25th several further attempts to cross the ditch were foiled, and the brushwood was occasionally set on fire by grenades, torpedoes, rags soaked in oil and tar, tar barrels, and other combustibles, but the fires were soon extinguished. The Japanese fired a small charge in the exterior slope of the parapet itself to facilitate escalading, and masked their approach from the right salient by a strong sandbag traverse. On the 26th another assault was checked by fire from the retrenchment, and a counter-attack with the bayonet drove the assailants back into the ditch.

On the 1st of December the Russians heard from the passage the sound of Japanese pickaxes, and there was no longer any doubt that the latter were mining under the parapet. Information was also received from Fort Song-shu-shan that the mouth of the gallery was visible, and might even be destroyed by a lucky shot. On the 8th of December owing to the rocky nature of the soil the Japanese had to blast in their gallery under the left salient, the explosions were distinctly audible, and the blows of picks were also heard under the centre of the front face. On the 18th of December a reinforcement of 12 sappers was sent from North Ki-kwan after it had been captured by the Japanese. The Russian countermine galleries were now only 13 and 10 ft. long respectively.

On the 21st of December General Gorbatovski issued an order, based on the lessons of North Ki-kwan, in regard to the dispositions to be made when the front face was blown up. The craters were to be occu-

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pied at once, the troops taking filled sandbags with them. The cover would be better there than further in rear. The men were to be warned that there was nothing to fear from the explosions, and that the escalading would be carried out with some reluctance.

On the 27th the Japanese charged their mines, and, by keeping men at work with picks, completely deceived the Russians as to what was going on. The explosion was therefore quite unexpected. It occurred on the morning of the 28th, and was so violent that the walls of the barracks were shaken and the lights extinguished. Two large craters were formed, one on each side of the entrance to the passage under the ditch, and though formed in rock, the parapet was absolutely shorn off to the level of the terreplein. Large numbers of the assaulting troops were buried under the débris. The fort was shelled vigorously, even 11-in. guns being used. Ensign Poseda collected what troops he could find to defend the front face, but the Japanese held them at bay, and fifteen minutes after the explosions threw themselves on to the parapet. The Russian batteries and forts within range deluged the glacis and ditch with projectiles, but as they were themselves subjected to a heavy fire from the Japanese, their fire was not very effective. The Japanese succeeded in occupying and crowning the craters. Capt. Boulgakov, Commandant of the Fort, twice tried to lead parties from the barracks against the enemy, but the outlets were only wide enough for three men abreast, the Japanese machine guns mowed them down, and the counter-attacks failed. At 11 a.m. the fougasses prepared on the left flank were fired, and attempts were made to fire the charges placed under the foundations of the guard room, but they failed to explode. The central battery was by this time a ruin, but the Russians still held on to it. During the afternoon the Japanese crept slowly on, and at length captured the retrenchment. They now commanded the exits from the barracks, rapidly established flying saps, then a deeper trench in which they placed machine guns. Small parties tried to work round the flanks and turn the gorge, but still Capt. Boulgakov would not give in. At about 10 p.m. Lieut.-Colonel Gandourine, who was in command of that section of the defence, ordered the evacuation of the fort, and made arrangements for removing the wounded. The garrison retreated, taking with them their machine guns, ammunition, and provisions. The evacuation was completed by 2 a.m. on the 29th of December. The bedding in the barracks was saturated with kerosine, and set on fire, and the fuzes attached to some torpedoes stored near the gate were lighted. The bursting of these destroyed part of the passage, and the Japanese, for fear of further explosions, only entered the barracks next day. There remained in the fort three dismounted 6-in., seven 2-in., and a few other guns, which had all been rendered unserviceable before the evacuation.

Fort Song-shu-shan was of similar construction to the two forts above described, but was in trace triangular, with a blunted apex. The right flank was 82 yards long, the left 70 yards, and the gorge 83. The parapets had not been constructed, nor the ditch levelled. The flank ditches were enfiladed by casemates in the apex of the counterscarp, a caponier across the ditch joined these casemates to the fort, and provided flanking

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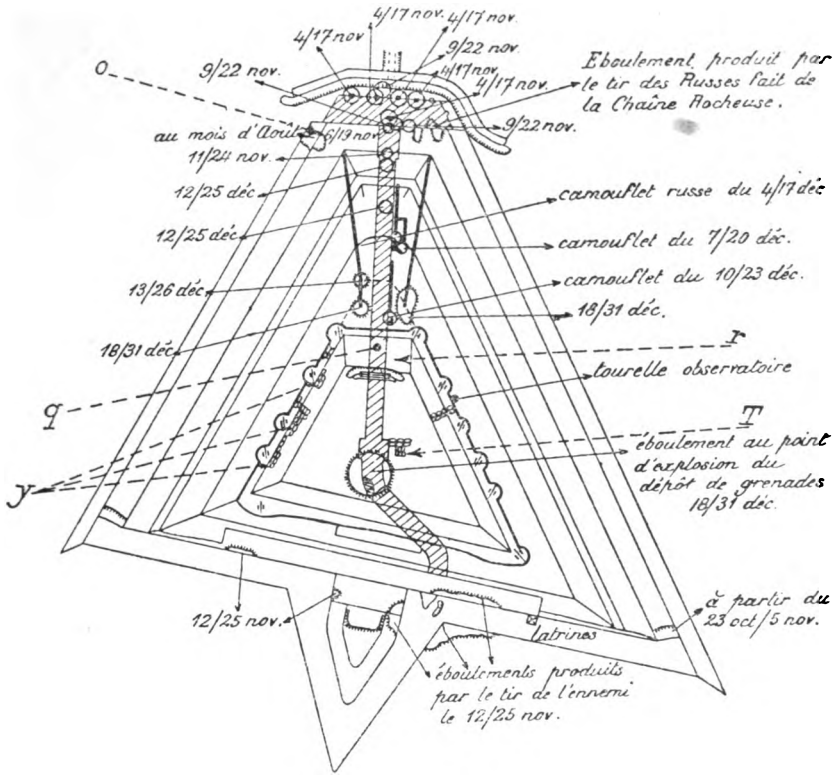
fire for the short front face. To prevent an enemy from using the roof of the caponier as a bridge, it had been intended to fix an iron palisade across it, but this had not been made when the siege commenced. The concrete barrack closing the gorge was a low narrow corridor with barred windows. Opposite the centre and joined to the barrack was a caponier to flank the gorge ditch and containing officers' quarters, etc.



Work No. 3.—Scale 1 : 2000.

To the right of the gorge caponier, on a level with the ditch, was a door leading into the barracks. Opposite this was a passage leading up to the terreplein in the centre of the fort, where were openings to each side, covered by traverses. Beyond these openings the passage descended again to the caponier and casemates in the apex of the fort. Across the terreplein the passage was unroofed. On the outbreak of the war the parapets and revetment of the counterscarp were hurried on, and above the barracks, under the gorge parapet were placed blindages to serve as kitchens, stores, etc. The garrison was one company and a detachment of artillery. The glacis was surrounded by wire entanglement.

By the end of October, 1904, the fort had already successfully resisted several assaults, and the Japanese were established at the foot of the glacis. It had been proposed in September to countermine from the front casemates, but it was hardly expected that the Japanese could

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mine in the rocky soil, workmen and special tools were wanting, and countermining was postponed till the 27th of October, by which date it was evident that the safety of the casemates was imperilled. Two galleries were then commenced from the back of the casemates. On the 30th the Japanese made another assault, but their scaling ladders were too short to reach the bottom of the ditch (28 ft. deep). Their saps had, however, nearly reached the crest of the glacis over the casemates, and from thence they sallied out and threw bags full of rags into the ditch, and returning again, repeated the operation. They then jumped into the ditch and climbed the exterior slope. Received by the fire of the garrison from the parapets and casemate, and by reverse fire from the neighbouring works, they were forced to retreat with loss. During this assault a shell burst in the passage across the fort, killed two officers, one of whom was Capt. Chemetillo, Commandant of the Fort, and exploded a magazine, which caused great damage to the exits from the passage on to the terreplein. Fortunately reinforcements arrived at that moment.

The Japanese now crowned the glacis with a sandbag parapet, and commenced sinking shafts to blow in the roof of the casemates. On the 31st the Japanese ladders left in the ditch were destroyed with torpedoes. On the 5th of November the Japanese were clearly heard working on the roof of the casemate. It was decided to close the openings into the countermines, which had only been driven for about 7 ft. each, and on the 7th the casemates were vacated, and the opening into the caponier was walled up. This work was completed by the 10th, and meanwhile the sinking of the Japanese shafts was interrupted as much as possible by grenades, torpedoes, etc. The Japanese fixed thick wire screens to protect themselves, and many of the missiles burst harmlessly.

Owing to the hardness of the rock the Japanese mines were only ready to fire on the 17th of November. There was one on the roof, and six in the back wall of the casemates. Two of the latter missed fire, but the back wall was pierced and the front wall shaken. On the 18th the Russians retired behind a breastwork which they had built in the passage where it opened into the caponier, and placed a pom-pom there. The Japanese made further attempts to wreck the casemates, and on the 22nd a charge was exploded against the caponier, but did little damage.

On the 26th another assault was repulsed; the Japanese began to mine under the parapet, and the Russians sank a shaft and placed 35 lbs. powder at the end of a short gallery driven through the right wall of the passage just behind their first breastwork. It was to be fired electrically when required, but the wires were broken, and the mine was never used. Meanwhile a duel took place between the Russian pom-pom and a machine gun fixed by the Japanese in the casemate at the outer end of the caponier. Grenades were also used, and the air in the passage could hardly be kept fresh by a diver's pump placed at the outlet into the fort. It was now found that the Japanese were mining outside the right wall of the passage, and on the 5th of December the first breastwork was forsaken for a second about 25 yards further back. Some days later the first breastwork was partly wrecked by the Japanese. Another mine gallery was driven out to the right from behind No. 2 breastwork,

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and it and the passage were lighted by electric lamps. On the 6th the Japanese were heard at work in the caponier and in the parapet of the front face, and it was proposed to make a sortie to ascertain what they were doing, but the idea was abandoned. On the 11th various noises betrayed to listeners in the passage the gradual advance of the Japanese. The Russian gallery behind the second breastwork had been driven about 6 ft., and then turned to the front at right angles, parallel to the passage. On the 15th it was calculated that the head was about 5 ft. from the Japanese gallery. A mine chamber was excavated and loaded with 100 lbs. of powder, tamped with sandbags and wooden frames. To prevent damage to the wall of the passage sandbags were piled on the inside and strutted back from the opposite wall. Blows on the wall of the passage deceived the Japanese, who had no idea that a mine was being charged. At 2 a.m. on the 17th the countermine was fired and must have been effectual. Heartrending cries were heard, and numbers of Japanese rushed out of their gallery into the ditch.

From Japanese sources it has been ascertained since the war that the Japanese were working on the following plan. First, by Boules' shafts to demolish the caponier, and second, to make two covered ways in the parapet to enable them to reach the interior of the fort without being hammered by the neighbouring works. To this end they had driven two galleries, one on each side of the passage, from the extremities of the front face. Then perceiving that the fort possessed this passage they drove a third gallery outside its right wall. It was this gallery that was damaged by the Russians.

In spite of careful tamping the passage had been filled with fumes, and could not be entered for half an hour. Nine hours later sounds of mining were heard further to the rear, the countermine gallery was untamped, and a branch commenced at an angle of 135 degrees. Three days later it was about 11½ ft. long, and the Japanese were close enough to be reached by a second camouflet. 70 lbs. of powder was placed in position and fired. The effect on the enemy was insignificant, and owing to poor tamping the passage was filled with smoke. The Japanese were soon at work again, and it was decided to remove the tamping and prolong the gallery, and also to begin another gallery near a third breastwork which had been built across the passage just in front of a vertical through the superior crest of the front parapet. However the Japanese were heard at work outside between the second and third breastworks, and work was concentrated on the new gallery only. This was sufficiently far advanced by 23rd for 40 lbs. of powder to be placed in it and fired. The enemy's gallery was destroyed, and the tamping was so carefully carried out that no fumes entered the passage. On removing the tamping the end of the Japanese gallery was found to be exposed, and a hail of rifle bullets greeted the miners. 20 lbs. of powder was laid in the open and fired, driving back the Japanese. It was decided to bring up a small q.f. gun, and then enter the enemy's mine, but while arrangements were being made the Japanese fired a mine laid on the ground, killing and wounding eight Russians. Work was now suspended on both sides.

The detachment of sappers in the fort had been reinforced on the 20th of December, and fresh galleries were driven right and left from the

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passage just behind the third breastwork. The Japanese were heard on the 23rd working on the roof between the first and second breastworks, the latter was therefore demolished in case it might be of use to them. The roof was blown in on the 25th, and grenades thrown into the passage, which produced such a suffocating smoke that the Russians had to retire behind their third breastwork, where a 1½-in. gun had been placed. On the 26th the Japanese fired a mine in the front parapet. Their tamping seems to have been insufficient, and little damage was done, the loopholes were unharmed, and the sentries remained at their posts. Grenades were thrown into the crater, but no assault was made by the Japanese, although they opened a heavy fire on the fort. On the 27th the Japanese tried to enter the passage, and threw in asphyxiating grenades, but the Russians kept them at bay.

By the 28th all the parapets were broken down, and through the earth banks covering the barracks the concrete walls showed in places. The outlet from the passage which was damaged on the 30th of October had been repaired, a sandbag parapet protected it on the right, and after the capture of East Erh-lung it was found necessary to protect the left flank by a parados. Preparations had also been made to blow up the barracks in case of necessity, 10 shafts had been sunk with chambers for 60 lbs. of guncotton each, and were ready by the 30th. On that date the work was violently bombarded. Charges had not been placed in the shafts in the barracks, but were stored under the beds, with detonators and Bickford's fuze ready fixed.

At 9 a.m. on the 31st two explosions sounded from the parapet caused by Japanese mines on either side of the passage. That on the left had little effect, on the right an oblong crater appeared, but still the crest was untouched. However the consequences were most disastrous; the garrison issued in a mass from the barracks, when a soldier struck with his foot a grenade placed in a magazine in the passage. The magazine blew up instantly, killing a large number of the defenders. Besides this, for some reason as yet unexplained, the charges of guncotton placed under the beds in the barracks were detonated and wrecked the whole building, 122 men out of the 250 then in the fort being killed. The Japanese rushed in over the ruins of the barracks and occupied the gorge, and the reinforcements hurried up by the Russians were forced to retire. General Gorbatovski telephoned an order for the garrison to surrender, seeing that it was impossible for more than a very few to save themselves by flight. 128 were made prisoners, of whom 65 were wounded. The subterranean war had lasted two months.

It may be deduced from the foregoing that as a general rule one mine gallery is insufficient. The opponent then has full liberty of action, and can avoid the danger. A system of galleries is required, especially in the case of defence by countermines.

One salient fact in all these operations was the capture, after a comparatively short period, of the casemates flanking the ditches of the three works. Shortly stated the events were as follows:—After the failure of their general assaults in August, the Japanese proceeded to construct regular siege works. In September and in October they again tried to carry the works by assault from a shorter distance but again

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failed. At the end of October at Fort North Ki-kwan, after ten days of close approaches, they were in touch with the left end of the casemates, and on 30th they obtained possession of that end, but, hindered by the second Russian countermine, one branch of which protected the right half, it took them three weeks to completely capture the whole block. At Erh-lung East, where countermining was not commenced in time, the flanking work was taken on the 30th of October after a week only of close approaches. At Song-shu-shan, on the 5th of November, the Japanese threatened the walls of the casemates, there were no countermines, and the Russians being unable to make any defence had to abandon the flanking work. Comment is superfluous: the courage and stedfastness of the troops is unquestionable, it was only want of weapons, *i.e.*, of countermines, that led to the loss of the forts. A more stubborn defence of the glacis above ground could not have put a stop to the Japanese approaches. On an average, 2,000 grenades a day were used by the Russians besides other projectiles. Numerous sorties were made, which except for small local successes had no real effect on preventing the Japanese progress whether by sap or mine. The result would indisputably have been very different had a sound system of countermine galleries, prepared in peace time, been available from which to initiate a systematic underground defence.

A second fact which stands out clearly is the blowing up of the parapet as a prelude to the final assault. In all the three cases above described the processes were similar. After the capture of the works flanking the ditches successive assaults were attempted, preparations for which were made by constructing passages across the ditch, or by collecting scaling ladders and footbridges. Thanks to the mutual support afforded to each other by the forts, the more fragile implements were rapidly destroyed. The old methods were then resorted to, the counterscarp was demolished, forming several roads for columns into the ditch, and heavy masses were poured over the parapet. As a preliminary to the last, the parapet was razed to the ground and thrown into the ditch, and to effect this the Japanese attacked with the spade the dead angles in the ditch, and buried themselves in the parapet out of reach of grenades and other projectiles, their progress only being interrupted by a few hastily constructed countermines. The parapets which had valiantly withstood the heavy artillery were not proof against these methods. The explosions disheartened the garrison while the ardour of the attackers was enhanced, and rushing over the smoking ruins the latter were soon in possession of the conquered fort.

We may here be allowed to diverge slightly from subterranean warfare to emphasize the close connection which ought to exist, during the attack on a fortified position, between the sappers and the infantry. After a lapse of two centuries it is no longer the artillery that must be enabled to close round the work, but the infantry. There are obstacles to destroy, gaps to be made in wire entanglements or other accessory defences, ditches to be filled up, parapets to be blown down, and conquered localities to be made good. All this is the work of the sapper, who precedes the infantry and smooths his path. A thankless task very often; the general public has a tendency to ignore the fourth arm.

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At Port Arthur, for the final assault on the works, a battalion of sappers always preceded the infantry, and there is no doubt that success was in a great measure due to the intimate association of the two arms. It is well to lay stress on this fact, viz., that strong bodies of sappers, carefully trained and disciplined to meet the difficulties and complexities of their comprehensive duties, are absolutely indispensable in the attack of fortified positions.

Among various surprises afforded by the Russo-Japanese War must be mentioned the use of mining in field warfare. During the winter of 1904–05 the belligerents were stationary for some months on the banks of the Sha-ho. The distance between the outposts was barely 100 yards. The *Revue du Genie*, 1907, Vol. XXXIV., p. 5, published details of this episode of the war. The Russians held the right bank, the Japanese the left, the latter also held the bridge of the Trans-Siberian Railway and had organized a bridgehead on the right bank of the river. To capture it the Russians constructed several retrenchments, and then advanced by sap and mine. To meet this move the Japanese drove two galleries, one along the railway embankment against one of the retrenchments, the other against the Russian mine. On the night of 27th February the Russians attacked the bridgehead, and a reconnoitring party of sappers entered the Japanese galleries, securing as trophies several objects left behind by the Japanese in their precipitate flight. The bridgehead was abandoned.

There was another war of mines at the village of Li-chia-pu, where the Russians occupied a fortified retrenchment about 300 yards from the village temple, which was held by the Japanese. In November, 1904, a Captain of Engineers proposed driving a gallery to blow up the temple, but his suggestion was not adopted till the middle of the following January. It then became clear that the Japanese had carried a quantity of earth out of their temple, and subterranean noises were heard. The General accordingly ordered a system of countermines to be prepared in front of the retrenchment, work was put in hand and proceeded at the rate of about 25 ft. a day. By the 24th of February the head of the gallery was rather more than half-way to the temple. Noises were still heard, and the Russians, becoming apprehensive, opened a branch gallery, and on the 27th a Japanese miner's pick pierced the floor of this gallery. Several mine chambers were then made and loaded; in all 2,000 lbs. of powder were used, and on the 28th the Japanese gallery was destroyed. There had been no means of ventilating the long gallery; the miners frequently collapsed, and had to be relieved.

The war in Manchuria inaugurated the era of long battles, and without drawing general conclusions from these episodes of the war, it may not be rash to predict that in certain circumstances mines may be used in the attack and defence of fieldworks. Certainly defended positions which form pivots of manœuvre might well be protected by fougasses with electric connections carried underground; the vulnerability of conductors laid on the surface is too well known. Fired at the right time these fougasses might check the impetus of an assault more surely than any other means.

The writer concludes his interesting work by a short discussion of

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the probability of a European conflict being of sufficient duration to call for the employment of mining. It may be assumed that, in order to bring the war to a conclusion with the least possible delay, every legitimate means will be employed to defeat the adversary, and of these means mining is certainly not the least. The timely establishment of countermines will provide for the early extension of an active method of defence. In view of this possibility, however important may be the theoretical and historical study of the effects of mines, such study is not to be compared with practical experience. Mine warfare is, without doubt, an excellent way of training officers and men, it develops initiative and a sense of personality. The problems to be resolved are various and call for instant decision, the caprices of powder and the trickiness of soils demand constant study, the anxiety to guard against surprise stimulates listeners and observers, the deductions to be made in regard to the distances of sounds strengthen the judgment, and the old stager will form a correct opinion from one single fact where a beginner would fall into error. Attack and defence by mining should undoubtedly be practised constantly during peace, the lessons to be drawn from it are invaluable.

A.R.R.

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NOTICES OF MAGAZINES.

REVUE MILITAIRE SUISSE.

No. 5.—*May*, 1916.

FIRE ACTION AGAINST AEROPLANES.

The article on the above subject commenced in the *Revue* for April, 1916 (*vide R.E. Journal* for July), is continued in the May number of the publication.

In this part of the article, the question of directing fire at targets at considerable altitudes above the earth is mathematically examined as a problem in elementary ballistics. If the trajectories of projectiles aimed at stationary targets at various altitudes above the earth, but at the *same distance from the spot whence the projectiles are assumed to be discharged*, be plotted a number of parabolic curves will be obtained. An examination of the curves thus obtained will at once show that where two targets are situated, one on the same horizontal plane as that from which projectiles are being fired, and the other at a considerable elevation above this horizontal plane, *e.g.*, so that the line of sight makes an angle of 40 degrees with the horizontal plane, then in taking aim the backsight must in the latter case be set for a shorter range than in the case of the former target.

If a number of trajectories for targets at various altitudes be plotted, it becomes possible to ascertain by inspection for what range the backsight must be set so as to hit an elevated target at any known distance from the point of discharge of the projectile aimed at it. Where the target is vertically above the firing point the range at which the backsight must be set to hit it is always a minimum for a given distance between a moving target and the firing point.

For a projectile to be effective against a given target it must possess sufficient energy ($E=\frac{1}{2}mv^2$), at the moment the target is struck, to do damage. The energy of a projectile in flight decreases very rapidly with the range, *e.g.*, in a particular case where the energy of a projectile is 2,700 ft.-lbs. at the muzzle of the gun, it falls to 270 ft.-lbs. at a range of 2,000 yards. As a rule, therefore, it is little use firing at aeroplanes in flight at ranges exceeding 2,000 yards.

Some of the expedients adopted by the machine-gun companies of the Swiss Army for utilizing their weapons against aircraft are referred to in the *Revue* article, and a number of photographs are reproduced showing detachments with machine guns ready for action against aircraft.

NOTES AND NEWS.

Switzerland.—A special contributor writes that the Federal Council and the General Staff have during the past few weeks been issuing a series of notes and orders on aerial defence and army boots. The Swiss soldier is said to have been hitherto very badly shod, but henceforth there will be little reason to complain in this respect.

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A further violation of Swiss neutrality, more grave than that when German bombs were dropped on Porrentruy, is stated to have occurred; a German aeroplane has flown over and bombarded Delle. This time not only has the incident roused anger in French-Swiss circles alone, but also in other quarters. The Federal Council is said to have delivered an "energetic" remonstrance to the offending Power, and has received profuse apologies. The Swiss Government has decided that the incident shall now be regarded as closed.

Meanwhile, measures have been taken by the higher authorities to give "air pirates" a warm reception when next they come uninvited over Swiss territory; sentries and detachments are now permitted to open fire against foreign aircraft on the orders of an N.C.O. as well as of officers; formerly they could only do so on the order of an officer.

A reference is made to the arrival of the wounded and sick soldiers who are to be interned in Switzerland, and the hope is expressed that these victims of duty will derive benefit from their sojourn in the Swiss mountains.

The confidence shown by the belligerents in entrusting the care of their wounded soldiers to the Swiss is much appreciated by them: they expect not only that the soldier visitors will enable them to make good some of the loss arising out of the War but see in the arrival of their visitors also a guarantee that Swiss neutrality will be respected.

Portugal.—A special correspondent refers to the fact that Germany has at last declared war on Portugal. The doctrine of the German diplomats is that he who is not with Germany is against her. The Portuguese showed at the very beginning of the War to which side their sympathies inclined. Since then Portugal has done all she could to assist her historical ally, Great Britain. To the fact that Portugal has been thus loyal to an old friend has been attributed the invasion of Angola, on which occasion the Germans murdered the Portuguese Commandant of a frontier post. The torpedoing of Portuguese merchantmen was probably due to the same cause. Fortunately, the Portuguese Government was in a position to retaliate with effect, and promptly requisitioned the German ships which had taken shelter in her neutral waters. The action of the Portuguese Government in requisitioning the German shipping in Portugal was perfectly legal, since the doctrine of "Eminent Domain" has still the fullest force in that land; there was no violation either of the municipal law of the country, or of international law, or of treaty obligations. However, Germany sent a note declaring the action of Portugal to be a violation of international law and also of treaty obligations and in consequence broke off diplomatic relations.

The Portuguese are not in any way disturbed by the German thunder.

No. 6.—June, 1916.

PREVENTIVE MEASURES IN RELATION TO NERVOUS AND MENTAL DISEASES IN THE ARMY.

The article dealing with the above subject appearing in the number of the *Revue* under review is a reprint of a paper read before the "Société suisse de Neurologie" on the 14th May, 1916. The author of the paper points out that the world-wide war now raging has brought home to

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every thinking person, in a more forcible manner than any other event in the history of mankind, how imperatively necessary it is that an army shall be composed wholly of men who are absolutely sound in mind and in body. Among the "undesirables" of an army none are a greater source of danger to it in the field than men liable to nervous or mental disorders. Such men may easily place an army in extreme peril at critical moments, and are at all times a dangerous and disturbing element; they should be got rid of as quickly as possible after the symptoms of their malady are first observed. Naturally it would be better still if "defectives" could be prevented from joining the colours altogether. The success of the preventive measures for dealing with nervous and mental disorders among soldiers depends on the thoroughness with which "undesirables" belonging to the mentally defective classes are kept out of the ranks of an army.

A very wide field would have to be covered in order to deal with the subject of the paper exhaustively; the intention of the author of the paper is not so ambitious, he confines himself to the treatment of preventive measures in connection with certain diseases under the three following heads:—

(i.). Recruiting for the army.
(ii.). Campaign against alcoholism.
(iii.). Prevention of venereal diseases.

In the introductory part of the paper extracts are given from statistical tables relating to the diseases under investigation as affecting the Swiss Army. It would appear that from the date of the mobilization of the Swiss Army on the 1st August, 1914, to 31st December, 1915, 28,050 men were invalided; out of this total 4,602 cases (*i.e.* about one-sixth) were due to alcoholism, and mental and nervous diseases.

Recruiting.—The question of the classification of men invalided from the Army is discussed under the heading "Recruiting." It is pointed out that the Swiss instructions for the classification of the men invalided out of the service are based on the *Prussian Instructions for Medical Officers*, issued in 1858 and revised in 1875. In accordance with these instructions men discharged on account of mental derangement are shown under two main groups, (*a*) congenital infirmities (*e.g.*, feeble-mindedness, lunacy, idiocy) and (*b*) mental diseases properly so-called. The question of the classification of invalided men under the various subheads of these two groups is next discussed and it is pointed out that the French expressions used for the subheads in the German classification are, at times, not strictly correct from a pathological point of view, as for instance in the translation of *geistige Beschränktheit* by *manque d'intelligence*. It is pointed out that this question possesses an importance greater than that of the mere choice of words; for recruiting purposes it is essential that precise information of the causes for which men were invalided should be on record and this necessarily involves the use of words which clearly define the entries found under them. For it must be borne in mind that serious mistakes made in relation to recruiting may have far-reaching effects on the finances of a State.

The number of men invalided from the Swiss Army between the 1st August, 1914, and the 31st December, 1915, for tuberculosis is next

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dealt with. This number was 4,572, that is to say, nearly equal to the number invalided for alcoholism and mental and nervous diseases referred to above. Men suffering from this disease make bad soldiers.

The author of the paper is of opinion that it would be a mistake to discharge all epileptics from the army in accordance with the strict interpretation of the letter of the law. Many of those in this class of "undesirables" are capable of useful service in the non-combatant ranks, so long as they abstain from alcohol.

Those who desire further information on this branch of the subject are recommended to read *Les maladies mentales dans l'armée suisse* (*Le Caducée* of 5th June, 1909) by Dr. Haury, and *Les anormaux et les malades mentaux au régiment*, by the same author.

Campaign against Alcoholism.—As was the case in Germany and in France, so also in Switzerland as soon as mobilization was ordered a great wave of intemperance passed through the land. The measures adopted in various countries since the beginning of the War to fight the drink curse are touched upon in the paper. Control of the liquor traffic by the restriction of the sale of intoxicants to soldiers has proved most effective. In an article which appeared in the *Intransigeant* of the 9th April, 1915, the statement occurs: "In the army, alcoholism has been almost entirely stamped out. For many months past the men in the front line and in the trenches have not tasted alcohol; they have become accustomed to doing without it, they have ceased to have a longing for it, they do not even think about it."

In some "Notes" by a sub-prefect published in the *Revue de Paris* for 1st May, 1915, the statement occurs: "The modern young man contemns alcoholism and debauchery. . . . Out of about 2,400 conscripts of the 1915, 1916, and 1917 classes, I did not see a single one drunk, either before the Appeal Tribunal or in barracks. . . ."

Prevention of Venereal Diseases.—It is hardly necessary to draw attention to the part alcohol and syphilis play in the etiology of nervous and mental diseases. An examination into the personal or the hereditary antecedents of the majority of persons suffering from nervous or mental breakdown discloses either alcoholism or syphilis (or both these) as a contributory cause of the patient's condition.

Medical men have unfortunately divided themselves into two separate and opposing camps on the question of the methods to be adopted for combating these diseases; those who are for regulating prostitution and those who advocate its total abolition.

The author of the paper urges that medical men should deal with this question as one of hygiene and of therapeutics, and that they should not mix up with the medical aspects of the question considerations affecting police measures concerning public decency and offences against the moral law.

It is suggested that the two best methods of meeting the situation are (*a*) by giving lectures to the troops and familiarizing them with the dangers of alcoholism and of venereal diseases, and (*b*) by providing healthy recreation and amusements for soldiers during their leisure hours, in order to draw them away from drinking dens and loose company.

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THE BELGIAN ARMY IN THE FIELD.

In the rapid survey of the operations of the Belgian Army which appears in the June number of the *Revue* two questions broadly are considered; first, what could one have reasonably expected from the Belgian Army at the period just prior to the War? And secondly, what has been the real influence of the part played by the Belgian Army in the great European struggle?

If, just prior to the 1st August, 1914, the question had been put, What do you think the Belgian Army will be able to do in the coming war? A large majority of people in Europe would unquestionably have replied: Not much. This was certainly the general opinion held in Germany, as events have proved. However, the course of the War has shown how erroneous were the opinions held even in quarters where a correct appreciation of the situation might have been expected.

A very large number of Belgians had as little confidence in the power of their army to defend the Fatherland as the Germans had respect for it. The vast majority of the Belgians were entirely opposed to an increase in military power on the part of their country, and a large number of deputies had successfully sought election to the popular Chamber on a clearly antimilitarist ticket. The formula adopted by an important group of the Government party was: No one need be a soldier against his wish (Niemand gedwongen Soldaat).

The Roman Catholic Press lulled the public to sleep by teachings of which the following is a brief summary: "The great Powers of Europe have guaranteed by their signature our neutrality and our independence. We cannot take up the attitude that we have no confidence in their pledges. Why then should we maintain a powerful army? Against whom can we use it? All we want is a small army of sufficient strength to do police duties as a frontier guard as was the case in 1870."

The Belgians now know what faith to put in treaties and guarantees.

In spite of the ridicule heaped by many Belgian politicians on their army, there were clear-sighted patriots in the land who worked assiduously with the object of seeing that their country was provided with an army capable of meeting her needs as well in relation to her geographical position as in relation to her wealth and economic power. No one worked more devotedly in the interests of the little kingdom in this matter than the late king, Leopold II., and he was ably assisted by Baron de Broqueville, the present Belgian War Minister.

The Belgian Army prior to the War.—Some little time before the present war the Belgian Army was in a deplorable condition and was deteriorating more and more as each day passed.

Officially, the Active Army had a strength of 100,000 men and was organized into four Divisions and two Cavalry Divisions.

The four Divisions each consisted of 12 battalions of 1,000 rifles each, a battalion of carabiniers, two regiments of artillery (72 guns), an engineer group and military police.

The two Cavalry Divisions consisted each of four regiments and two batteries of artillery.

The peace establishment was 42,500 men (about $\frac{1}{180}$ of the population). The annual drafts of recruits amounted to 18,000 men. Colour service

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only lasted 15 months in the infantry. The effective peace strength was much below the peace establishment. For financial and other reasons many men were always compulsorily absent on leave. Thus ordinarily not more than the equivalent of half the numbers of the peace establishment were present with the colours. The Belgian Army was indeed a phantom army. Companies were only from 15 to 20 strong, so that companies and battalions from many different regiments had to be brought together from the several garrison towns in order to form units of suitable strength for training purposes.

In considering the value of Belgians as soldiers it is said that they are on the whole an intelligent, willing and tenacious people, but their independence and capacity for fault-finding renders them somewhat insubordinate.

The natural characteristics of the recruit, as stated above, and the general conditions which existed in the Belgian Army had, as might be expected, an unfortunate influence on the training of the soldier. Discipline was very lax, and the perpetual interference on the part of civil and religious authorities, when punishments were awarded to offending soldiers, tended to accentuate this unfortunate state of affairs. It is not surprising then that even the keenest officers became dispirited in time.

The officers of the Belgian Army are on the whole a well educated and intelligent body of men, who have received a very thorough education in military subjects. Wasters there certainly were in the Officer Corps when war broke out, but as soon as hostilities began they were given short shrift.

The Belgian Army took the field well armed and equipped, except that it was without heavy artillery. It started the War with 324 field pieces (the "75" gun) and 120 machine guns (these were of the Hotchkiss and Maxim types).

A detailed examination into the causes which led to the fall of Antwerp, Liège and Namur would be interesting, but the consideration of this question is reserved for a future occasion. As is well known the fortifications of Antwerp were being remodelled when war broke out, and the detached works provided for the defence of this important place were still without their new armament.

The uniform of the Belgian Army in the pre-war days was perhaps the most unpractical and anti-hygienic of any worn in Europe. Attempts to introduce reforms had failed owing to the intense conservatism of the older school of officers.

Briefly then, prior to the outbreak of the War, the Belgian Army was weak in numbers, ill-disciplined and poorly trained; the Belgian Nation reposed too great confidence in treaty stipulations, moreover it was unwilling to bear the cost of defensive measures. The general situation in the little kingdom was not calculated to raise the spirits of its well-wishers.

Nevertheless the part played by the Belgian Army in the present war has been considerable.

The fight put up by Belgian troops at the beginning of the War, very probably settled the final issue of the Great Conflict now raging. The stand of the Belgian Army on the banks of the Meuse, of the Gette,

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of the Nether and lastly on the Yser undoubtedly upset the strategic plans of the Great General Staff in Berlin. The crushing German blow intended to be delivered at France miscarried in consequence. The intervention of the Belgian Army was the sand which threw the German machinery out of gear. By the time the last of the forts at Namur had surrendered, the mobilization of the French Army was completed. During the first three weeks of the Campaign Germany, it is said, found it necessary to detach half a million men from her invading army to deal with the Belgians. In the western theatre, Germany set in motion 12 Army Corps at the beginning of the War; these Corps were preceded and flanked by 12 cavalry regiments and accompanied by 2,000 guns, heavy and light. During these three weeks, the Germans are said to have suffered losses amounting to 10 per cent. of their effectives. The Belgians had, at this time, little more than 100,000 men in the field.

During the next phase of the operations—end of August to October 1914—the remnants of the Belgian Army contributed valuable assistance to the Anglo-French troops in Belgium. For many long days, the Belgians held up several German Army Corps which were urgently required by von Kluck and for the German outflanking manœuvre in the north of France.

During the decisive days of the fighting on the Marne, the sorties of the Belgian Divisions in Antwerp caused serious inconvenience to the Germany Army; troops on the way to reinforce the Germans opposing General Manoury had to be diverted to Antwerp.

The fortress of Antwerp had little influence, *per se*, on the operations; it stood no chance against the long-range heavy artillery brought against it.

The last phase in the field operations in which the Army of King Albert played a part was at the First Battle on the Yser, and here again, it accomplished great things. The German advance on Dunkirk and Calais was barred by Belgian soldiers, and the German attempt to outflank the Allied Armies in Flanders and northern France was thus completely foiled. The German hope of a rapid and complete victory faded away here. Since those days what remains of the Belgian Army has been engaged on the left of the long line which extends from the North Sea to the Alps, adding to the renown of the great deeds it accomplished in the autumn of 1914.

The *Revue* article is illustrated with photographic reproductions relating to the Belgian Army.—(*To be continued*).

THE PSYCHOLOGY OF DRILL.

There are some who argue that drill is of value as an educative factor in forming and strengthening will power and that this can be shown to be true on psychological grounds. Advocates of the use of drill as a means for developing will power hold the view that the rational method of training will power consists, in the earliest stages, in the rapid and accurate execution of certain simple muscular movements which are repeated until the stage of perfection is reached.

Such persons desire to strengthen the will power of a soldier in the same way that a man develops his muscles by repeated relaxations and

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contractions of the same; the object aimed at by them is to inculcate the most implicit obedience in a soldier.

The writer of the *Revue* article admits that drill can be usefully utilized for training will power, but too much drill, he says, only causes a man to lose interest in soldiering, and bores him; too much drill destroys the spirit of troops, gives rise to discontent and hence weakens the *morale* of the soldier. The greater the value that a man puts on his individuality the greater is the destructive effect of too much drill; this is so more particularly in a highly democratic country and in the case of an army composed of citizen-soldiers.

The principles contained in *Scouting for Boys*, by General Sir Robert Baden-Powell, are, in the opinion of the writer of the *Revue* article, better adapted for training soldiers for defensive warfare than drill. These principles are psychological; they tend not only to raise the *morale* of the man, but at the same time to improve his technical knowledge.

Notes and News.

Switzerland.—In a reference to the arrival of wounded British soldiers in Switzerland surprise is expressed at the hostile attitude shown by a part of the Swiss Press towards Great Britain. It is pointed out that Switzerland has less reason for anticipating difficulties in her relations with Great Britain than in the case of her powerful neighbours, particularly in view of the principles of liberalism and tolerance with which the British public are imbued.

Attention is called to the article by Monsieur André de Bavier entitled *L'Angleterre Chevaleresque* published in the *Revue des Jeunes* for 10th April, 1916, in which are discussed the policy of Great Britain and the moral principles on which the character of the British people are founded. In the article in question it is shown that British statesmen have at all times held out for the rights of other nations, even when Great Britain's interests have been adversely affected thereby. The Chinese War of 1856 is cited as an example; in this case many Englishmen openly stated that their own country was in the wrong and China in the right. On this occasion a Vote of Censure was moved against the Government, which at that time enjoyed the popular favour and could have met the situation by dissolving Parliament. Nevertheless the Vote of Censure was passed; 263 members voting for and 247 against the motion. Another example quoted is the moral support given by the British Press to Switzerland in 1861, when the Swiss Confederation came into collision with the Government of Napoleon III. in relation to the claim of the latter to the Vallée des Dappes in the Canton of Vaud.

Great Britain had already done Switzerland a signal service in 1847, when Austria and Prussia were about to interfere in Swiss affairs at the time of the Sonderbund. Lord Palmerston set his face against the interference of foreign Powers in this matter and thus enabled the Federal Diet to deal with the situation promptly and effectively. General Dufour soon put an end to the Sonderbund and the pretext for foreign intervention immediately disappeared.

Canada.—A special correspondent contributes an article in which attention is drawn to the part Canada has been playing in the world

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war. Canada has set herself the task of providing a contingent of half a million men out of her population of 8,000,000. Up to the 1st January, 1916, she had raised 225,000 men, of whom 120,000 have crossed the Atlantic. The enrolment of the balance of 275,000 men is being prosecuted with vigour.

Canada's contribution to the Expeditionary Force consists mainly of infantry; artillery is difficult to raise and train in a colony such as Canada and there has been no very great demand for cavalry since resort was had to trench warfare.

The Militia is being retained in Canada as a sedentary reserve to meet unforeseen eventualities, but the officers are allowed to transfer to "Overseas" battalions. Officers who have returned from the front are in many cases attached to the "Overseas" battalions now in training in Canada; in spite of climatic difficulties the new levies are being rapidly trained for service in Europe.

Special schools have been formed for the training of officers. At the McGill University, Montreal, a special Canadian Officers' Training Corps has been formed. The University has already furnished 200 officers and 2,000 N.C.O.'s and men to the Army.

The cost of the Canadian Contingent is being entirely borne by the Colony. The Dominion has also organized workshops for the manufacture of munitions, and 454 workshops, employing some 225,000 persons, are at the present time busily engaged in turning out shells, etc.

The question of finding employment, on the declaration of peace, for those who are now fighting the Empire's battles is receiving attention. A proposal has been put forward by a Canadian M.P. that a certain number of positions in the public services should be reserved for men who have served at the front. The President of the Canadian Pacific Railway, Lord Shaughnessy, is interesting himself in a movement having for its object the settlement of soldiers on the land as agriculturists.

This number of the *Revue* concludes with a Bibliography.

W. A. J. O'MEARA.

RIVISTA DI ARTIGLIERIA E GENIO.

April, 1916.

GERMANY.

Incendiary Bombs and Explosive Bombs thrown from Airships.—The bombs thrown from the Zeppelin which made an incursion over Paris on the night of the 30th January belong to two types; incendiary bombs and explosive bombs. The first have been described in this review. The others according to the *Génie Civil, No.* 8, are of spherical form constructed of steel or of castings of relatively small thickness—from 15 to 25 mm.—and of two sizes; one with a diameter of 320 mm. and a weight of 60 kg. and the other having a diameter of 380 mm. and a weight of 100 kg. The internal charges are respectively 20 kg. and 30 kg. and of trinitrotoluene. A percussion fuze is used with a small retarding end or tail which lasts for a considerable time so that

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the bomb when it strikes a building does not burst until after it has penetrated deeply, thus causing grave damage.

From calculations it is inferred that one of these bombs falling from a height of 3,000 m. would assume in a vacuum a velocity of over 240 m. per second; actually on account of the resistance of the air the velocity would probably be less than 200 m. per second. A bomb weighing 60 kg. fell on a tunnel not far from a station where the vaulted arch is less than 2 m. in thickness; the bomb produced a crater of 5 by 6 m. dimension, but the railway lines were not damaged and the traffic was soon restored. A building of 5 stories with brick walls of 33 cm. was entirely demolished by the explosion of another bomb.

One of the enemy's dirigibles threw 18 explosive bombs of 60 kg. and 100 kg.; it was estimated that the charge of these was about 1,400 kg.

Another airship threw 19 incendiary bombs and 27 explosive bombs, the charges of these being over 2 tons.

Twenty-six persons were killed and 27 wounded.

UNITED STATES.

Increase to the Defences of the Panama Canal.—The Panama Government is showing itself disposed to assign to the United States the land required for the construction of new batteries of heavy calibre at the mouths of the canal according to the project prepared by General Goethals for improving their defences. These lands will comprise the city of Chagres at the mouth of the river of the same name, and several other small towns and suburbs. The treaty between the State Department and the Ministry of Panama is proceeding on good terms, says the *Army and Navy Journal* of New York.

Coast Defences.—At the military meeting of Congress General E. M. Weaver, Commandant of Coast Artillery, speaking of the reorganization of the Army said that it would not be impossible for a fleet effectively to bombard New York and San Francisco previous to a disembarkation; he declared that the conditions of these two towns are such as to need all possible attention, since the guns posted for their defence have not sufficient range to keep at a distance ships armed with the latest powerful weapons. He added that measures should be taken to remedy provisionally this situation, installing 40 cannon of 305 mm., that were now at Sandy Hook, on carriages permitting of great elevation, and long ranges, while there are under construction cannon of 406 mm. for sea defences with ranges equal to those of the most powerful guns carried by modern ships. It should not be forgotten, adds General Weaver, that for probability of striking the target and exactness of fire, the coast guns are to those installed on board ships as 8 to 1.

FRANCE.

Consumption and Production of Munitions.—When in France Albert Thomas was nominated Under-Secretary for Munitions the problem presented to him was to produce with the greatest possible care, an enormous quantity of war material according to the requirements of the supreme command of the army. But there were no factories in working order, material was wanting and 50 per cent. of the workmen had been mobilized.

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Four of the French departments occupied by the Germans (Nord, Pas de Calais, Ardennes, Meurthe and Moselle) represented alone 77 per cent. of the French metallurgical industry (6,723,000,000 tons on a total production of 8,714,000,000 tons). The Germans had occupied in the north of France, the fossil carbon mines, which previous to the War gave 68 per cent. of the entire production of fossil carbon of France; they have now in their hands 68 per cent. of the French production of coke, 76 per cent. of steel.

It is calculated that at the commencement of hostilities France disposed of resources of 3,235,000 h.p. of which 1,173,000 or 34 per cent. were in the above-named departments. All this horse power was lost by the French and utilized by the Germans. Of useful machines now working, 81,675 belong to the four departments of which more than 16 per cent., 12,887, are now for the most part working for the German war industry. Under such circumstances it was no light duty for M. Thomas to create an industry to double the production and to provide the skilled workmen for want of whom a great number of offices were closed.

Some time ago the French Minister of Public Works ordered an inquiry on the condition of 26,610 establishments that in peace times employed 1,097,670 employees; the result being that while in August, 1914, 42 per cent. of those employed were absent—for the most part at the Front—in the following October there were at work 68 per cent. of the normal number.

Since it was evident that the issue of the War depended upon munitions, a great number of workmen were recalled by a decree from the Front and were sent to work in the munition factories.

The quantity of material and of munitions required for the War seems almost incredible. In the War of 1870–71 the German Artillery did not in any battle fire more than 200 shots per piece; during the Russian-Japanese War the consumption of munitions was doubled; in the Battle of Tachicaio one Russian battery fired an average of 522 shots per piece.

Altogether 817,000 cannon shots were fired during the Franco-German War of which 479,000 were against fortifications and the rest in field battles; during the Russian-Japanese War there were 954,000 cannon shots; at the commencement of the first campaign the most intense artillery fire took place at the Battle of St. Privat when 39,000 shots were fired.

With these lists it is interesting to confront the following from the present war; in one day, over a front of only 8 km., the German artillery fired about 100,000 projectiles; the consumption was even more during the battles in Galicia; a French communication of the 17th June, 1915, relates that to the north of Arras, in the course of 24 hours, the trenches and the German reinforcements were struck by 300,000 projectiles, as many as were fired by the German Artillery in the whole of the campaign of 1870–71.

The weight of these 300,000 projectiles was about 4,500 tons, and for their transport 300 large railway wagons and 4,000 munition cars were necessary. These 24 hours of fire cost France 9,375,000 francs.

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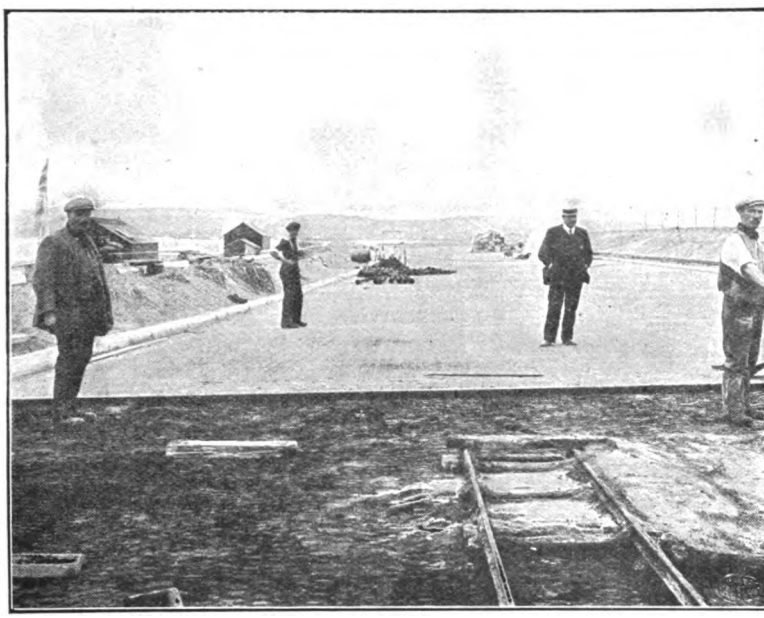

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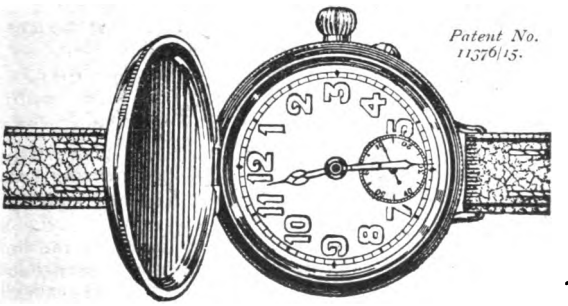

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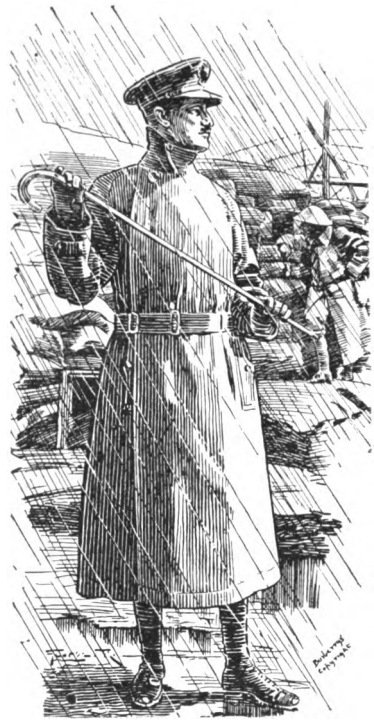

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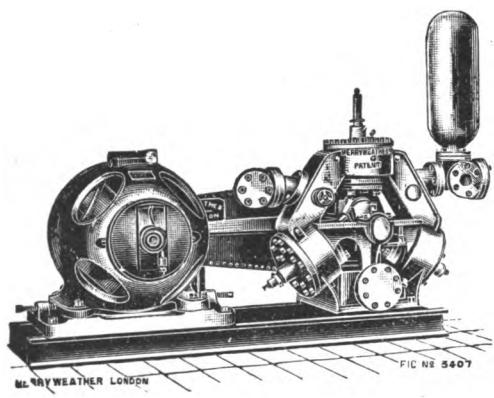

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BATH HOUSES IN THE FIELD.

By CAPT. L. B. O. TAYLOR, R.E.

THE provision of some simple form of bath house in the field for troops is very desirable.

The following details, with drawings, of bath houses may be of interest and assistance to Royal Engineers who have to carry out this class of work. Details are given below for an installation suitable for from 4,000 to 5,000 men, and one suitable for a company, and a bathroom for officers.

Bath House for 5,000 *Men.—Plate* I. shows the design of the building which is practically a copy of W.O. plans and calls for no remarks. Forty shower baths are provided, and the capacity of the bath is about 800 men a day. From 3—5 gallons is allowed for each man. Hot and cold water tanks each hold 400 gallons and are on the same level; and, being at the highest point of the circuit, are open tanks. The hot-water tank and all hot-water piping were lagged with tarred roofing felt. The boiler consists of four parallel lengths of 2-in. pipe, joined together with the necessary tees and bends, and laid in a trench similar to that of a field kitchen. Brick baffle walls were built alternately above and below the pipes, and the upward slope given to the boiler was $\frac{1}{22}$. This was proved quite sufficient. Wood or coal can be used as fuel.

Plate II. gives details of the circulation system which is entirely on the primary circuit, and very simple. The hot-water return passes through a non-return valve, a full-sized drawing of which is given vide *Plate* II., *Fig.* 6; and then joins the cold-water feed from the tank to the boiler. By the introduction of this non-return valve it is claimed that whatever quantity of hot water is drawn off, it is impossible for the cold to gain any mastery over the hot, and this has been borne out in practice. The action of the non-return valve is briefly as follows:—The normal position of the valve is open, as shown in *Fig.* 6. As soon as hot water is drawn off, the rush of cold water to the boiler closes the valve, and keeps it closed until hot and cold tanks are both filled, and the system is balanced again. The circulation of water in the hot-water circuit due to water being heated in the boiler opens the valve again. In practice the valve has proved very sensitive and efficient. A syphon is fixed in the cold-water feed, between the cold tank and the point of junction with the hot return, its function being to prevent any chance of the

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hot water going up into the cold tank. Showers are provided, those illustrated being readily made by any tinsmith. Two systems for giving hot and cold water at the showers are illustrated in *Plate* II., *Figs.* 4 and 5. That in *Fig.* 5 is recommended, as although more wasteful of fillings, each man can mix hot and cold water to his own liking, whereas in *Fig.* 4 the cold water introduced serves five showers.

No complicated fittings of any sort are required in the bath house as illustrated here, and all stoves, etc., used are easily obtainable. The non-return valve is simple to make, and the one shown was made in the company in a very short time. It is found that from 1½ to 2 cwt. of fuel are used daily. Hot water is obtained in about one hour after lighting up, and the fire can be allowed to die down about an hour before the final baths are taken.

The bath house costs £650 in all to build, the cost being divided as follows :—

Labour	£120
Materials and transport	£530

The cost of materials in this part of the world is nearly three times the cost at home, and it is estimated that a similar building could be built complete at home for £350.

The time taken to erect was a little over three weeks.

Plate III. gives details of a system suitable for a small bath house. A single length of 1½-in. or 1-in. pipe or a combination of the two bent into coils in a field forge can be used; or as in the case illustrated the coils can be made up of 2-in. bends and sockets. The coils can be laid either horizontally or vertically, and appear to be equally efficient in either position.

Installations similar to this were put in for company baths and for officers' baths in a corps headquarters and have proved satisfactory, ample hot water being obtained within an hour of lighting the fires. No design for a bath house is given as any small shed can be readily adapted. In all cases illustrated a good head of water was obtained and no pumping was therefore necessary.

The arrangement of circuits in the large bath house is believed to be original, and was suggested by Sergt. T. Hagger of this company, who also invented the non-return valve. He has had great experience in hot-water engineering work in civil life prior to joining the Army, and worked out all the details given here.

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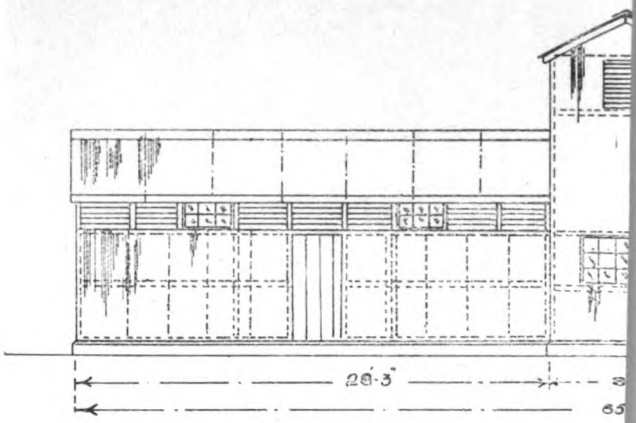

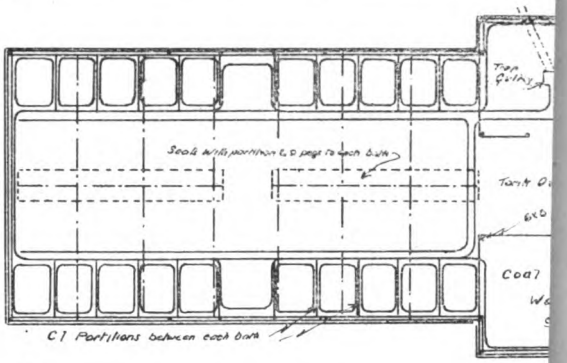

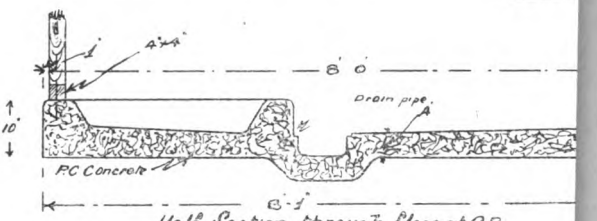

Half Section through Floor at A.B.

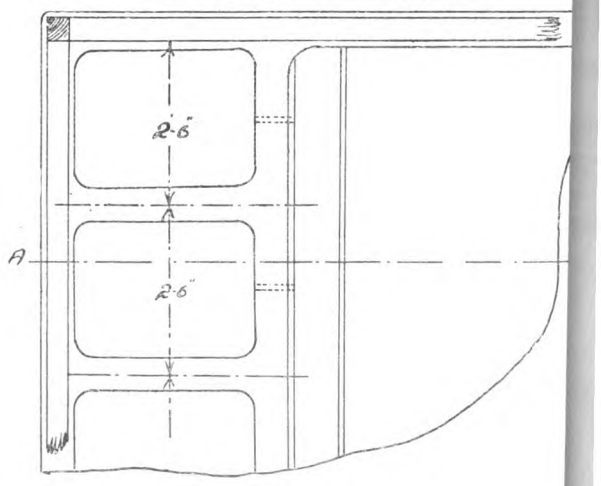

Fig. 6.

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GEOGRAPHICAL PROBLEMS IN BOUNDARY MAKING.

By COLONEL SIR THOMAS H. HOLDICH, K.C.M.G., K.C.I.E., R.E.

(*A Paper read at The Royal Geographical Society*).

THE delimitation of an international frontier is the business of treaty makers who decide on trustworthy evidence the line of frontier limitation which will be acceptable to both the nations concerned, with all due regard to local conditions of topography and the will of the peoples who are thus to have a barrier placed between them. These are the two first and greatest considerations, and they involve a knowledge of local geography and of ethnographical distributions. Dependent thereon are other important matters which may largely influence a final decision—matters which may include military, political, or commercial interest, but all of which are subject to geographical and ethnographical conditions. It is only quite recently—within the last half century or so—that geographical knowledge has been considered an important factor (or considered a factor at all) in the education of the political administrator.

Fifty years ago the whole wide area of scientific knowledge embraced in the field of geography was narrowed to a ridiculous little educational streamlet which babbled of place names and country products. Scanty as was the educational value of geographical teaching fifty years ago, it was almost equalled in its feebleness by the practical knowledge of the subject which included the all-important matter of map-making. True we had our geodetic scientists, and much profound thought and practical energy had already been devoted to solving the riddle of the Earth's form and dimensions, such as laid the foundation for an after-extension of valuable bases for surface measurement which would sustain the building up of maps. But it was not the development of map-making alone which led to the better appreciation of the absolute necessity for scientific geographical education in the widest sense of the term. It was the discovery that we were being left very far behind in the field—not so much of pioneer research (there we have always held our own)—as of that practical knowledge which profoundly affected our position as a commercial nation, our prospects in the military field, or our political dealings with other countries when the question arose of partition or spheres of interest, that forced the conservative hand of our educational administration and led to the formation of geographical schools throughout the country. In

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short, it began to be quite clear that geography was a science that had to be reckoned with, and which it paid pre-eminently to study.

We have found now by the experience of the last twenty to thirty years that certain provisional methods, methods which involve the use of a smaller class of instruments and wireless telegraphy, and lead to rapid progress in advance of strict geodetic measurements, are quite sufficient to enable us to spread out our map system on comparatively small scales of work over the vast areas that are of primary interest to the commercial, military, or political geographer, without the accumulation of any error that would invalidate the map. This is the sort of work nowadays which is voluntarily undertaken by many travellers, and which gives us results that are far beyond those of earlier geographical pioneers in value. It is this sort of work which is wanting whenever a political discussion arises as to respective spheres of national interest in wide and only half-explored regions, and which usually remains wanting. It is often the fact of the possession of geographical data of the most absurdly elementary type that enables the commercial pioneer to succeed in striking effectively in the development of a fresh trade area. The details of such work concern the actual processes by which frontiers are secured, and belong to the demarcator, who completes the boundary demarcation when delimitation has taken shape in the form of an agreement or treaty between the high contracting parties. It is with the form of delimitation, and the primary necessity for trustworthy geographical information in the first place, and of sufficient geographical knowledge to prevent the misuse of technical terms that we are now concerned. This is an age of boundary making, of partitioning and dividing up territory, and it has by no means come to an end yet. It may well continue as long as the world endures. The territories to be partitioned, to which political boundaries have to be set, may be those of highly developed and well-mapped countries, or they may be dark and remote and guiltless of any map-illustration, which can be accepted as good enough to guide the work of demarcation. All sorts of countries, under all sorts of governments, from the black barbarism of Central Africa to the hothouse civilization of South America, have been subjected to the process, and of all of them may the same thing be said, *i.e.* that the process of frontier defining has resolved itself into a strictly geographical problem. It must always be so. A boundary is but an artificial impress on the surface of the land, as much as a road or a railway; and, like the road or the railway, it must adapt itself to the topographical conditions of the country it traverses. If it does not, it is likely to be no barrier at all. Boundaries have been twisted out of every conceivable natural feature with more or less success. The first preliminary to a boundary settlement should be, if possible, a reasonably accurate map of the country concerned;

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but this is not always available, and it may happen that the mere agreement between two countries upon an abstract definition may be all that is necessary or possible for the time being. In that case, a store of future trouble is laid up if, in the terms of delimitation, it is not made clear that this arrangement is provisional only.

Here, then, we find the first rock upon which delimitation treaties split. It is the want of geographical knowledge. If, indeed, it is compulsory ignorance, if there is no possibility of waiting till maps can be made, the arbitrators are forced into the position of adopting the worst of all possible expedients—the straight line—then a provisional or inelastic agreement must take the place of a more elastic boundary.

Some very notable instances have occurred lately in connection with boundary settlements in Central and Southern Africa which illustrate the disadvantages of the straight line. In one case a meridian line was selected before even such preliminary investigations were concluded as might have determined a fairly accurate longitude and fixed a point on that meridian. The result was an awkward international complication as soon as it was discovered that a wide tract of valuable land had been erroneously assigned to England which subsequently had to be transferred to Belgium. In that case I think I am right in stating that quite enough of the geographical features of the country were known to decide whereabouts the dividing line ought to run, only unfortunately the meridian fixed upon did not happen to represent that line. There was little excuse for the mistake. In another instance a definite meridian was adopted which traversed a desert—the Kalahari desert—of South Africa. This is the eastern limit of what was German South-West Africa as it stood before the War. Now a desert may form an excellent frontier in itself, just as may the highest altitudes of a great range of mountains where the eternal snowfields and the remoteness of an uplifted wilderness are never trodden by the foot of man. It is true that even in deserts, African or Asiatic, wild nomadic tribes may exist who can band themselves together for mischief and who can raid across the frontier into each other's territory; and to them it may be desirable to point a landmark, either natural or artificial, and to say "You may not pass that mark." Outward and visible evidence of a barrier is the only thing they can understand. But how does a meridian help the matter? It is not only neither outward or visible without demarcation, but it may be very difficult and very expensive to determine. In this case a lengthy series of geodetic triangulation had to be carried from Cape Colony to the south of the boundary till it entered German territory, entailing years of scientific labour in a most unwholesome climate, and costing a sum equivalent to the value of many thousands of square miles of useful geographical mapping, in order to determine with

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some approximation to scientific exactitude where that meridian really lay. This was before the days of wireless receivers and the interchange of time signals.

Next to absolute blank ignorance of the geographical conditions which prevail in the theatre of boundary operations perhaps the sharpest and most dangerous rock in the delimitator's course is an inaccurate or assumed geography on which to base his treaty. Perhaps the most remarkable instance in recent history of this form of delimitation error is afforded by the dangerous antagonism which arose between the two great South American Republics of the Argentine and Chile with reference to the partitioning of Patagonia. Patagonia had only recently emerged from primæval conditions of barbarism under Indian occupation. Opportunity for exploration had been small, and the usual result of geographical enterprise along the Pampas bounded by the Andine foothills had been disastrous to the geographer. Such knowledge as was at the disposal of the high contracting authorities who met in July, 1881, to frame a treaty which should dispose of Patagonia between the two claimants had been furnished chiefly by old-world records of missionary enterprise which were seldom illuminating as map illustrations of the Andine territory. Later and more scientific inquiries carried out by competent explorers revealed the fact that the text of the treaty was based on inexact geographical knowledge. Throughout the northern territories of these two Republics the international boundary for thousands of miles had been determined by a line which was eminently satisfactory to both parties. It was the great divide of the Andes which parted the waters of the Pacific from those of the Atlantic. Nothing could have been better. As a natural barrier it is magnificent; as a definite line of partition facing the trespasser either way it may perhaps be difficult to recognize here and there, but as such intervals are just those which no trespasser from either side can possibly approach this is a matter of no consequence whatever. The extension of such a line to the extreme South of Patagonia, where the Andes end, so far as South America is concerned, was the simple and effective solution of an international difficulty that presented itself to the political arbitrators. The treaty laid down the principle that Nature's excellent management for a central water parting should continue to furnish the boundary, and decreed that it should be maintained by the main range of the Cordillera of the Andes which parted the waters of the Pacific from those of the Atlantic to a point near the Straits of Magellan. When, however, geographical explorers took the field it was not long before they discovered that the conditions of the treaty were irreconcilable.

The Southern Andes break up into a mountain system which still contains all the grandeur of snow-capped ranges, seamed by magnificent glaciers, and presents to the Pacific a snow-crowned rampart

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of majestic forest-clad hills, with, here and there at intervals, the white pinnacle of a volcano dominating its walls. But on the Argentine side it softens down towards the pampas and plains into a comparatively irregular formation of lower ridge and valley, flanked by broad terraces, scarlet and purple in autumn with all the glory of the Patagonian beech scrub, and infinitely varied both in form and feature. This lesser Cordillera encloses valleys of great beauty, and is frequently traversed by lakes of surpassing loveliness, the waters of which draw this way and that, taking their sources sometimes from the flats and "Masetas" of the Argentine plains, and passing right through the mountain system to an exit in the Pacific. This, to the treaty makers, was unexpected and vexatious, and experts on either side were deputed to prove that the boundary could follow but one course, which course (according to the side from which the argument proceeded) was either the main range of the Cordillera (*i.e.* that which was highest and most dominating) or else it was the main water parting—the great divide—of the continent, which sometimes followed a prominent range and sometimes was lost in marshy flats. War seemed the only possible termination of the dispute. Millions, many millions, were spent in ships and armaments, and the foundation was laid for an effective army trained on the latest military principles (German chiefly) on either side of the Andes. It really appeared as if a most natural assumption of geographical conformations which did not exist were destined to set back the tide of splendid progress of which both Republics could boast, and to wreck them on the shores of a long, bloody, and probably indecisive war. Fortunately stern good sense prevailed in the end, and British arbitration, crowned with the King's award, was accepted with deep gratitude by some and, I am inclined to think, relief by all.

Another instance of assumed geographical data for the basis of treaty making which led to results which were certainly awkward and expensive and which might have been dangerous, occurred in connection with the Russo-Afghan frontier. There was once, not so very long ago, a Liberal Government led by Mr. Gladstone, which was anxious to bring the tension of doubt and suspicion which surrounded Russia's proceedings in Asia to an end, and at the same time to deal very gently with Russia's political sensitiveness. This was to be achieved by setting a boundary between Russia and Afghanistan, and thus to draw across Central Asia a hedge beyond which Russia's progression southwards could not extend. There followed a meeting between high diplomatic dignitaries on either side (in which British interests were represented by that worst of all possible treaty makers, Lord Granville) and the delimitation of the boundary was duly effected. There may have been worse delimitations perpetuated since that day—I am inclined to think

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that there have been—but there has never been one in which less precautions have been taken to ensure that the map geography of the regions in question was accurate. There is this much excuse for the light-hearted acceptance of the ancient maps then in existence, that for the greater part of the delimitation, the Oxus River was itself to represent the dividing line; and the Oxus River, no matter how much displaced on the map, was a great natural feature which could not be missed. The trouble came with the definition of a particular point—the post of Khwaja Salar—as a boundary objective on the banks of that river. Great rivers which wander untrammelled and free through wide alluvial plains of their own making are not to be trusted as permanently bound by any banks which possess no artificial means of defence against corrosive action, and the Oxus (a splendid boundary in its higher reaches) is no exception to the rule in the plains of Afghan Turkestan. Two commissions, the unwieldy British and the compact Russian, spent weeks of diligent searching, with the interchange of much political controversy, over that wretched post, which was not of the least importance, and which had been washed in by the river and swallowed whole many years before the commissions met. The worst result, however, was delay in the field of Afghanistan whilst an uncertain-tempered and gout-ridden Amir (who was exceedingly anxious to be rid of the commission) dominated the political situation. It was, indeed, exceedingly dangerous, and we were well out of it.

Assumed geography hardly works more havoc with frontier treaties than does the misapplication of geographical terms. The main points of the land configuration may be sufficiently well known; maps may be fairly up to date, and the setting out of an agreement may be based on points and features that are fixed and unalterable. And yet the terms of an agreement may lead to most unpleasant discussion as to their meaning between rival commissions in the field, and may even be the means of breaking up proceedings altogether until the high contracting parties have explained themselves. Several such instances have occurred within my experience. One of the simplest occurred during the demarcation of the boundary between Afghanistan and those tribal territories which were to be reckoned independent and beyond interference by the Kabul Government. The boundary concerned passed through an open country—a country of hill and plain where the hills were sharply defined in long and generally continuous lines, sometimes knife-edged as to their summits, with steep rocky spurs deeply rifted by water channels. From the foot of the spurs there sloped away in smooth but often steep gradients the fans formed by detritus washed down from the mountain sides forming what is locally known in Baluchistan as "dasht." The "dasht" sometimes shaped itself into a broad and apparently smooth ramp 7 or 8 miles in width, a prairie land of

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low scrub and flowers in spring, a wide expanse of stone-dusted slope in winter, which stretched between the foot of the mountain spurs and the meandering course of the nullah bed which formed the main drainage line of the valley. A very considerable length of the boundary which was to be based on the mountain range or ridge was defined as following "the foot of the hills." Here at once was the opening for serious disagreement—and the disagreement promptly arose. What was the "foot of the hills"? Was it where the steep rocky spurs ended and the sloping grades of the dasht began? Or was it where the nullah ran in the midst of the plain and the slope from the hills could descend no farther? In the latter case one would have expected the boundary to have been defined in the treaty by the actual nullah bed rather than "the foot of the hills." That, at any rate, was the interpretation maintained, and the interpretation nearly led to a frontier war.

Another instance of similar slipshod definition occurred in the Asiatic highlands where the Pamirs spread out their gently sloping flats and valleys under the shadow of well-defined mountain ranges. So vast and so rugged are these ranges that it is only by grace of a glacial ramp that they can be ascended, as a rule. The connection between the triangulation which should determine the points on which to base the boundary between Afghanistan and Russia in these uplifted regions and that which supplied us with a series of fixed peaks in the Himalayas to the south was exceedingly difficult. However, it was accomplished, more or less successfully, and Indian triangulation was carried into the Pamirs and connected with the Russian surveys. This was important scientifically for reasons which concerned the demarcation of a boundary based on astronomical determinations of latitude. All went well enough after the junction was completed and accepted for the purpose of supplying initial data. The trouble arose when approaching the end of the demarcation; the boundary was defined in the treaty as running to the Chinese frontier. The definition was as follows:—"From this point the boundary shall run in an easterly direction to a junction with the Chinese frontier." What is an easterly direction? A little north of east? A little south of east? Due east? The expression was indefinite, and the interpretation involved the question of certain passes (whether they were of value or not we need not stay to inquire) which were considered as important at the time. The short summer and autumn were drawing rapidly to a close. Snow was settling deep in the passes Indiawards, and it seemed possible that ere an answer could be received to the simple question, "What is an easterly direction?" the camp of the commission would be snow-bound in those vast altitudes and condemned to an Arctic existence for the next six months. Naturally there was no agreement between English and Russian camps; and they arranged to

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separate for the winter. Much expense was incurred in collecting fuel and selecting the best shelter available for the next six months. It fortunately happened, however, that the weakness in geographical expression had been recognized in time. It appeared to be so certain to lead to complications as to justify an early reference to the chief contracting authorities in anticipation of such complications; and the reply, which determined the conclusion of the line on the basis of ascertained topography, was received just in time (and only just in time) to enable us to escape over the passes, already deep in snow and thickly shrouded with menacing snow mists, back to sunny India.

It is true that geographical nomenclature is by no means fixed. The question has been discussed with great diligence and careful research both by the Royal Geographical Society and the Geographical Society of America, but it is not with reference to the actual facts of land conformation in nature that trouble usually arises. It matters not much whether the technical classification of land forms is geodetic, based on the geological history of the formation, or whether it is simply physiological description expressing the character of the form in terms of its relation to other geographical features; whether the names of such features have a foreign derivation, or whether they are pure Anglo-Saxon, so long as the geographical definitions contained in a boundary treaty are technically accurate and precise in their meaning. Probably the actual loss to England due to the promulgation of boundary treaties drawn up with little or no regard to simple precision in statement could be reckoned in millions of pounds sterling. If a man were making a will full of complicated provisions, he would employ a lawyer armed with the full technical vocabulary of that rhetorical profession to make it for him. If he wishes to put a hedge between his own and his neighbour's estate he would take care that the agreement was correctly worded. But in defining a boundary between one nation and another not even the most elementary knowledge of geographical nomenclature has seemed to be considered necessary. To take the case already quoted of the boundary disagreement between the Republics of Argentine and Chile: nearly all the trouble arose from the interpretation of the words "main range." What is a main range? I could give you many other examples of equally indefinite description, but there is not space.

There is yet another shoal in the intricate sea of delimitation (even when the delimitation is based on sound topography) and that is the selection of some impossible geographical feature to carry the boundary. This is indeed not very usual, but it is very fatal to rapid and satisfactory progress in demarcation. An instance of this occurred in demarcating that part of the Indian boundary which separates Chitral (and Kashmir interests) from Afghanistan. Here

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the agreement defined the boundary as running parallel to the Chitral River at an even distance of 4 miles from the river bank. Thus it fell on the spurs of a flanking range, about halfway between the summit and the foot, festooning itself from spur to spur, cutting across mountain torrents and dividing water rights in accessible valleys, a continuous line of ascent and descent over some of the wildest, ruggedest and most inaccessible mountainside country that the Indian frontier presents, albeit it overlooks one of the loveliest of frontier valleys. Demarcation was an utter impossibility, nor could, or would, any tribesman of that wild Pathan frontier pretend to recognize such a line without an infinity of artificial boundary marks. Fortunately, it was possible to suggest an alternative without any great loss of time, and as that alternative was the well-marked crest, or divide of the range, instead of being halfway down its ragged side, and as the alternative would include a certain concession of (utterly unimportant) territory to the Afghans there was no great difficulty in effecting an alteration in the text of the agreement. Here again the hazard of the business was delay.

References to a few of the difficulties which have occurred in the interpretation of comparatively recent boundary treaties owing to lapses in scientific geographical description only prove that until lately the great principle of recognizing the geographical function of boundary demarcation, before proceeding to political definition in detail, was misunderstood. Quite recently, however, many boundaries have been settled in many quarters of the globe (especially in Africa and in South America) which have led to no disastrous disputes whatever, and have called for no arbitration. This is a satisfactory proof of the gradual development of geographical teaching for which the Royal Geographical Society may fairly claim a share of credit. To illustrate the advance made in geographical definitions we may refer to the position of geographical knowledge in the eighteenth century. Geographical terms in treaty definitions in those days was so vague as to be almost grotesque. There is one treaty with its attendant interpretations and the disputes arising therefrom which makes a good story, and is worth a reference, if only to set a point to our satisfaction at the gradual development of this branch of practical knowledge. The negotiations for the Canadian boundary from the Bay of Fundy to Juan de Fuca have really lasted into this century—but they commenced late in the eighteenth century. In November, 1782, representatives of Great Britain and the United States signed at Paris a provisional treaty of peace. It acknowledged the Independence of the United States. Article II. provided that between the United States and Canada "it is hereby agreed and declared that the following are and shall be their boundaries, viz., from the north-west angle of Nova Scotia, viz., that angle which is formed by a line drawn due north from the

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source of the St. Croix River, to the Highlands; along the said Highlands which divide those rivers which fall into the St. Lawrence from those which fall into the Atlantic Ocean, to the north westernmost head of the Connecticut River; thence down along the middle of that river to the 45th degree of north latitude; from thence by a line due west on said latitude until it strikes the River Iroquois or Cataraquy; thence along the middle of the said river into Lake Ontario," etc. The definition then deals with the series of great lakes and their connecting streams till the boundary reached the lake of the woods. "Thence through the said river" (lake of the woods) "to the north-western point thereof and from thence on a due west course to the River Mississippi" . . . "East by a line to be drawn along the middle of the River St. Croix from its mouth in the Bay of Fundy to its source, and from its source directly north to the aforesaid Highlands which divide the rivers which fall into the Atlantic Ocean from those which fall into the River St. Lawrence; comprehending all islands within 20 leagues of any part of the shores of the United States and lying between lines to be drawn due *east* from the points where the aforesaid boundaries between Nova Scotia on one part and East Florida on the other shall respectively touch the Bay of Fundy and the Atlantic Ocean; excepting such islands as now are, or heretofore have been, within the limits of the said province of Nova Scotia."

On 3rd September, 1873, a definitive Treaty of Peace was signed at Paris in which Article II. was repeated as above.

For geographical information the negotiators were dependent on a map issued in 1755 called Mitchell's map. It appears to have been a better map of North America than any previously published, but it was a fact which must have been well known to the negotiators that much of the country was absolutely unexplored. The childlike faith with which that map was registered as the basis of an important treaty sufficiently indicates the value set on scientific geography in England in those days. The following difficulties immediately presented themselves to the demarcators:—

1. Where was the River St. Croix? There were two rivers 50 miles apart, either of which might be the St. Croix of the map. The name was unknown locally.

2. What was the source of the river which was finally decided to be the St. Croix (in reality the Schowdic) supposing it had two branches (which it had).

3. What was meant by the *north-west angle* of Nova Scotia? Where was it?

4. What were the Highlands? Did they merely represent a divide, or were they actually hills?

The discussion of these questions lasted for many years. There was a long period of acrimonious dispute lasting about 50 years

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over the question of the Highlands alone, during which we were more than once on the edge of a war with the United States, and geographical theories were put forward which would lead to the conviction that a sense of humour has only recently been acquired by Americans. An ancient grant of all Nova Scotia made in 1621 to Sir William Alexander and defining the borders of that province was produced in evidence of former boundaries, from which it was clear that the expression "due north" from the source of the St. Croix had been substituted in the treaty for "northward"—and the western branch of the St. Croix (or Schowdic) had been adopted for the eastern. The first piece of pedantry cost England all the northern half of the state of Maine; the latter was not of great consequence. The "Highland" question was finally referred to the King of the Netherlands for arbitration, and that wise monarch, with the geographical acumen of a Dutchman, at once put his finger on the weak spot, and after pointing out that boundary disputes based on apocryphal geography must ultimately end in compromise, he decided that a divide was not necessarily hilly or mountainous, and awarded a line from the head of the St. Croix northwards as a "line of convenience" to the "north-west angle of Nova Scotia," and from thence by the St. Lawrence-Atlantic divide to the head of the Connecticut (which river also had two heads). The award did credit to his position as king of a nation of practical geographers; needless to say this did not satisfy the disputants, and the boundary finally accepted departs from the divide (to the advantage of Britain) for a space sufficient to destroy its value as a true geographical barrier. This arbitration treaty was signed in 1842. The area in dispute amounted to about 12,000 square miles, of which about 5,000 fell to Britain, who made concessions about the head of the Connecticut, where the 45th parallel had been wrongly determined.

Long before this fierce antagonism had been roused by the question of the fishing rights, and the ownership of islands in the Bay of Parquamoddy into which the St. Croix debouches. The geographical definition of a bay was called in question as soon as it was admitted on both sides that the "due east" of the treaty meant "due south." Was the Parquamoddy Bay a part of Fundy Bay? Was Fundy Bay the Atlantic, etc.? Difficulties here were not finally disposed of till the year 1910. From the head of the Connecticut to Wood's Lake there was no fundamental ground of dispute. It was found that the great chain of lakes really did link up one with another, and the only question that arose was in connection with islands in those lakes. In Wood's Lake, however, it was speedily discovered that no line running west from the north-west corner of the lake would ever reach the Mississippi; inasmuch as that river rose south of the lakes. Consequently the effort to reach the Mississippi was abandoned, and the 49th parallel of latitude was adopted as the

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international boundary under the mistaken impression that it was the northern boundary of Louisiana. The nature of this extraordinary boundary from the Lake of the Woods to the sea need not be referred to, but the final difficulty of San Juan's Island renders this story of an historical geographical muddle complete. The treaty maintained that the boundary was to follow the 49th parallel to the middle of the channel between Vancouver and the mainland, and thence pass southwards following the middle of the channel round the mainland. But between Vancouver and the mainland south of 49° north latitude there is an archipelago of islands, and at least three channels that might be called main channels leading through them southwards. Chief among these islands was San Juan. In 1859 a pig was shot by an American on San Juan and the American was haled before a British magistrate and threatened with imprisonment. This put a climax to the dispute, American honour was touched, and troops were landed from both sides. It looked as if the pig incident would lead to war; but the position was saved by arbitration, the Emperor of Germany being appointed arbitrator. The award gave away the whole archipelago to the United States.

It may be added that in 1870 the Canadian boundary at Pembina was found to be 4,700 ft. south of its true position in parallel 49 degrees. This was rectified and the work completed in 1874. Demarcation was effected in 1908. It has only just been completed (if indeed it is complete), but the cost of maintaining it will last through all time.

Absurd as are many of the incidents connected with the Canadian boundary, it may be doubted whether the Alaskan muddle was not almost equally remarkable. It was primarily caused by the purchase of Russian territory in Alaska by the United States, which included a strip of coast land extending roughly from Mount St. Elias, in South Alaska, to Cape Muzon and the Portland Canal to the west of British Columbia and bordering the Pacific. After much negotiation a convention was concluded at Washington in January, 1903, which was to decide the position of the boundary by reference to a tribunal. The difficulty of decision arose chiefly from the original terms of delimitation in the treaty of 1825. The boundary was to run northward from the 56th degree of north latitude (*i.e.* the head of the Portland Channel—or canal) "following the crest of the mountains situated parallel to the coast until its intersection with the 141st degree of west longitude, subject to the condition that if such line should anywhere exceed the distance of 10 marine leagues from the ocean then the boundary . . . should be formed by a line parallel to the sinuosities of the coast and distant therefrom not more than 10 leagues. If any continuous range such as the treaty demanded had existed with a crest uniformly parallel to the coast it might have been an ideal boundary, but the geo-

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graphical impossibility of such a disposition of nature seems hardly to have been recognized, and the question resolved itself into the determination of an irregular line in a mountain region which should never be more than 10 leagues from the ocean, and which should accord as far as possible with the condition of parallelism to the coast. This involved the secondary question of what is the coast line in such an archipelago of islands and islets as that with which the tribunal had to deal. The condition of strictly following its sinuosities was an impossible one. The tribunal finally decided on a line which was a mountain boundary practically in accordance with the contention of the United States. The line joined certain peaks marked on a map attached to the award forming a sinuous boundary about 30 miles from the general trend of the shore, and is, presumably, a line which it would be impossible to demarcate. The question of the course that the line should take from the point of commencement to the entrance to the Portland Channel formed an important branch of the award. This involved the right of occupation to certain islands. By the decision of the tribunal (with the strong dissent of two of the British members) the channel of the treaty was decided to be that which passes to the north of Pearce and Wales Islands, and which transfers two other important islands, Silklan and Kanna-ghunut, commanding the channel, to the United States, from Canada. The indignation which was aroused in Canada by this decision is a matter of comparatively recent history. It did, in fact, ignore one of the most important principles of boundary making when a compromise is in question. In the scheme for a fair and useful division between rival claims generally, it is most important to preserve the entity of any one concession in particular. For instance to divide a valley so that water sources are on one side and the irrigable lands on the other, is merely to invite the trouble which it is the whole object of a boundary to prevent. In this case the right of navigation through the channel to Canada, and the command of the channel to America by the cession of these islands, certainly seems to be a mistake.

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REINFORCED CONCRETE.

By H. M. WILSON.

THE following paper is reproduced by the kind permission of the Secretary of the Society of Engineers, Mr. A. S. E. Akerman, B.SC., A.M.I.C.E. :—

This is a form of construction that is engaging the attention of the best engineers. There is no doubt that many large structures in the future will be made of reinforced concrete, especially in the case of reconstruction work after the war.

Reinforced concrete has existed in practice and theory for more years than one would perhaps imagine. It is generally recognized that Mons. Monier was responsible for the first combination of steel and concrete, in order to produce a stronger material, as long ago as 1860. Metal had been used in conjunction with concrete previous to this, such as in the dome of St. Paul's Cathedral, and in some Roman work, but it is believed that these were instances of conjecture rather than calculation.

Portland cement is the finest material for the preventing the corrosion of iron and steel, but only if applied in the proper manner. People realized this, but were under the impression that the unequal expansion of the two materials would cause a combination to be a failure through their not adhering to each other. This theory was exploded by the experiments of Hyatt, Bonniceau, and others which conclusively proved that for all practical purposes the expansion of steel and concrete are the same. The coefficients of expansion for these materials being concrete, 0·000,006, and steel, 0·000,0065. After this the use of reinforced concrete became more extensive, and it has been increasing ever since, gaining greater popularity for constructional work each year, on account of its excellent and peculiar properties. Reinforced concrete is fire proof, incorrodible, vermin proof, increases in strength with age, and is unaffected (owing to its monolithic form) by vibration, and sometimes even by earthquakes.

America is at present the leading nation in reinforced concrete work, whereas England ranks only fourth amongst the nations in the work. It is sincerely hoped that this may not be the case for long, for England with her splendid engineers should be able to make great strides in this comparatively new branch of constructional work.

The Moduli of Elasticity of Concrete and Steel.—The modulus of elasticity of concrete has not as yet been accurately determined, the

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results of experiments varying from 6,000,000 lbs. per square inch to 500,000 lbs. per square inch. The modulus of elasticity of steel is far more constant, viz.: 30,000,000 lbs. per square inch. The ratio of the modulus of elasticity of steel to that of concrete is generally taken as 10, though some recommend the value 15.

Adhesion of Concrete to Steel.—This depends on two things, namely the area of the surface of contact and the nature of the concrete. For the best concrete the minimum adhesion is about 275 lbs. per square inch. This is only theoretical however, and in order to prevent the steel slipping through the concrete, owing to the diminution of the cross sectional area of the steel when loaded, the adhesion is taken as 100 lbs. per square inch. This uncertainty leads to the different forms of patent bars designed to avoid the necessity of having to rely on the surface friction by providing a mechanical bond between the steel and the concrete.

General Theory of Reinforced Beam Action.—It is generally assumed that the normal stress on a vertical section of a beam varies with the distance from the neutral axis, consequently the curve of the stress is a straight line.

The bending moment, and the resulting tensile and compressive forces have a maximum value (in the case of a beam freely supported at its ends and loaded with a uniformly distributed load) at the centre, and decreased to zero at the ends of the beam.

A beam reinforced horizontally alone fails through diagonal tension, for although the shearing stress may not in itself be sufficient to cause the failure of the beam, however small the amount of shearing force, it is accompanied by a considerable amount of diagonal tension.

In experimental work it will nearly always be found that a beam reinforced without provision being made for diagonal tension will break with 100 lbs. per square inch of shearing stress on the section, owing to the diagonal tension that results from it.

In theory the stirrups should be perpendicular to the lines of stress, but this is impracticable owing to the fact that the inclination of these lines is different at different points in the beam. The angle of 45 degrees occurs only at the neutral axis, and so there is really no reason why the stirrups should not be vertical, which is practically always the case, as stirrups set vertically are far less liable to get out of position when the concrete is put in place than they are if set an angle. The greatest diagonal tensile stress occurs at the extremities of the beam and it is, therefore, customary to bend up some of the tension bars towards the end so as to resist this force.

It is quite easy to put vertical stirrups in place, and they form a connection between the tension and the compression areas.

The adhesion of the bars to the concrete transmits the stress from the bars to the concrete, consequently this must always be checked as much as the tension in the steel.

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Horizontal bars placed near the bottom of the beam provide sufficient reinforcement for the central part of the beam, but additional reinforcement must be used at the extremities to meet the diagonal tension, as has already been mentioned.

Action of a Reinforced Concrete Beam under Loading.—(1). The beam acts as a true combination of steel and concrete until a stress of about 3,000 lbs. per square inch occurs in the steel.

(2). The neutral axis then rises and the concrete loses some of its tensile value, and the tensile stresses formerly taken by the concrete are taken by the steel.

(3). The position of the neutral axis remains fixed as the concrete has lost its remaining resistance to tension. Thus it is seen that the resistance of the concrete affects the deformation and deflection of the beam when the loads are small, but with greater loads the steel alone does take the tension, the resistance of concrete to tension usually not being taken into account.

Centering.—It is absolutely essential that the concrete should not be disturbed after it has been put in place, and on that account the centering must be of such a nature and design as to prevent this taking place and so that it can be easily eased and removed without producing a jarring effect on the recently completed work.

As in cast-iron construction it is desirable that there should not be any sharp corners, so in concrete work all sharp corners must, wherever possible, be avoided and round corners be constructed.

The timbering forms or shuttering used in concrete work can be lime washed or greased so as to give a rendering to the work and at the same time make their removal less difficult. A camber of at least ¼ in. in a foot should be given to all beams and slabs of reinforced concrete. The joints should be such that little leakage can occur. The forms should be arranged in such a way that the sides of columns can be moved first, then the sides of the beams and the centering, and lastly the supports below the beams themselves.

The sides of the columns can generally be removed about a week after the laying of the concrete. Fourteen days from the time of placement is usually allowed for the removal of centerings. The beam supports are allowed to remain in position longer so that the concrete may have a better opportunity of setting hard before the beam has to support the full dead load. The beam supports may usually be removed after three weeks from the time the concrete was put in place, but in cases of large spans this time should be increased.

The removal of all kinds of centering and forms requires a considerable amount of experience, and must only be done under the directions and supervision of the engineer in charge, as it involves great responsibility.

Water.—The amount of water required for mixing concrete depends upon the weather at the time of mixing as well as upon the nature of

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the aggregate and the sand. The concrete when mixed should be sufficiently plastic to remain at an angle of about 30 degrees in a barrow and not wet enough to drip when placed upon the centering. After the concrete has been rammed the water should just ooze to the surface.

Steelwork.—The steel should stand a stress of 34,000 lbs. per square inch before any appreciable set is apparent. It should stand bending, when cold, to an angle of 180 degrees round a bar of the same diameter without any fracture. No concrete work should ever be carried out when the temperature is that of freezing, or indeed if it falls below 39 degrees F., as at that temperature water is at its maximum density. If concrete has taken its initial set before frost comes on then it is quite all right, but the forms and centering must be left up for an extra period of time corresponding with the time the frost lasted.

Should a frost occur when the work is newly laid, it should be covered with sacking.

Placing of Reinforcements.—The steel must be in such positions that it acts in the best possible manner and as shown on the working drawings, and it is the duty of the engineer in charge to see that this is done. It is also of the greatest importance that they are not moved from their positions by the laying of the concrete. Concrete should be kept slightly wet for at least seven days after it has been laid. Careful examination must be made before the concrete is laid to ascertain whether there is any dirt in the centerings, and if there is it must be all removed before any concrete is introduced. All the centerings and forms should be wet at the time of laying concrete, so that the timber may not absorb any of the moisture from the concrete. Whenever possible the concrete should be placed in position from as small a height as possible, owing to the tendency of the cement to separate from the other ingredients when dropped from a height. All the concrete must be well rammed, especially round the steel bars.

The ends of bars projecting from any recently completed work must not be knocked or jarred, as such an action would damage the final set of the concrete and thus reduce its strength.

Columns.—In square columns three of the four sides are shuttered before the work is commenced. The steel bars are then put in place and the concrete is introduced from the open side, the fourth shutter being built up as the work proceeds.

Beams.—Sometimes it is found difficult to make the concrete pass between the bars of a beam, and in such cases the concrete may be made more liquid than usual.

Slabs.—When the centering has been erected, the bars should be placed in the positions allotted to them on the working drawings, being kept apart for the time being by the use of templates. The crossbars are wired to the main bars at frequent intervals and serve to keep the latter in position.

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Corrosion of Steel in Reinforced Concrete.—Much is said nowadays on the question of the corrosion of the steel bars in reinforced concrete; a considerable amount of practical evidence, however, enables all engineers experienced in reinforced concrete to state most emphatically that under no conditions is the steel adversely affected by the concrete. Chemical action takes place between the cement and the steel, calcium ferride is formed, and this prevents corrosion taking place.

In order to demonstrate, in a purely non-technical manner, the great difference there is between the strength of ordinary and reinforced concrete, the author made two beams, one of reinforced concrete and the other of plain concrete. They were both of the same dimensions, each being 2 ft. long, 1 in. deep and 1½ in. wide. The concrete in each consisted of:—Three parts of sharp river sand to one of slow-setting Portland cement. The reinforced beam had bars of an alloy, which consisted mostly of zinc, no steel bars small enough being obtainable. The reinforcing was placed ⅛ in. from the bottom of the beam. The stirrups were made of copper bell wire, six being placed at each end of the beam.

The beams stood the following loads:—Plain concrete beam—120 lbs. at the centre. The reinforced beam—470 lbs. at the centre.

In conclusion the author would like to urge upon his fellow students the advisability of reading up this subject, which is not only interesting to all engineers but which will undoubtedly be the great structural material of the near future.

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Colonel Arthur Moffatt Lang, C.B.

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MEMOIR.

COLONEL ARTHUR MOFFATT LANG, C.B., R.E.

ARTHUR MOFFATT LANG, born in Bengal, India, November, 1832, was the eldest son of Arthur Lang, Esq., I.C.S., and Sarah, only daughter of General R. Tickell, C.B.

Educated at Rugby and Cheltenham College, he entered Addiscombe Military College, from which he passed out at the head of his batch and winner of the Pollock Medal. He obtained a commission in the Royal (Bengal) Engineers in June, 1852, and on completion of the course of instruction at Chatham was posted as Assistant Executive Engineer to the M.W.D., joining the Rawal Pindi Division, Punjab, in November, 1855. He was appointed Executive Engineer and Superintendent of Civil Buildings, Lahore, in August, 1856, and in March, 1857, went to the Mian Mir Division. This was the year of the Mutiny, and Lieut. Lang was soon to pass through the most eventful period of his life.

We first hear of him at the Siege of Delhi, at which he was present throughout the operations. During the final stage he served under Capt. Taylor, R.E. (afterwards General Sir Alexander Taylor, G.C.B.), in tracing, building, and maintaining No. 2 Right Battery in daily tours of duty from 7th to 13th September. On the latter date he was ordered by Brigadier-General John Nicholson and Capt. Taylor to go down at 10 p.m. to inspect the breach which had been made in the Kashmir Bastion, as it was of the utmost importance that the assault should be delivered as soon as possible owing to the losses sustained by the troops, and the exhaustion of the gunners through constant and continuous service of the guns under the hot fire of the enemy's batteries. On the plea of imperfect sight at night, Lieut. Lang asked to be allowed to go while it was yet daylight. Taylor agreed, and with an escort of four men of the 60th Rifles, Lang crept to the edge of the cover in the Kudsiabagh, and then leaving his escort behind he ran up the 60 yards of glacis under fire, and from its crest made his notes about the breach. This done he leapt to his feet and, in his own words, "legged it for all he was worth" through a driving hail of bullets, getting back to cover unhurt.

The same night at 10 p.m. he conducted another Engineer officer, Lieut. George Medley, to the same place, taking an escort of six men of the 60th Rifles and a short ladder in order to ascertain whether ladders

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would be necessary in the assault. Unobserved the officers descended the 16-ft. counterscarp and Lang mounted to the berm and ascended the breach. The enemy had heard them, and a hasty retreat was made to the crest of the glacis. The party then ran back, followed by a volley from the rampart which fortunately hit no one.

For his gallant conduct on that day (related at length in the *Life of General Sir Alex. Taylor*, and also in Lord Roberts' *Forty-One Years in India*) Arthur Lang was recommended for the V.C. by Capt. Taylor and Capt. Maunsell, R.E. (afterwards General Sir Frederick Maunsell). This was not granted on the ground that the work was "within the line of duty." He was, however, "mentioned in dispatches."

On the following day Lieut. Lang guided the storming party of the 1st Bengal Fusiliers, H.M. 75th Foot, and 2nd Punjab Infantry 1,000 strong in all, led by the heroic Nicholson, to the Kashmir Bastion breach. The impetuous Lang was first up the breach, and feeling the muzzle of a Sepoy's musket against his chest, pushed it aside and thrust at the man with his sword, which to his dismay failed to pierce his opponent's kamarband and doubled back till it almost described a loop. Fortunately the kukri of a little Gurkha flashed over his shoulders, and the Sepoy fell, his head and shoulders almost severed from the trunk.

As General Nicholson, with Capt. Taylor, diverged with the 3rd column to Skinner's House in the city, Lieut. Lang, with Lieut. Pemberton, guided the 1st and 2nd columns along the ramparts past Moree Bastion, Cabul Gate, and on to Burn Bastion, which, however, was not taken, though many officers (including Lieut. Lang) reached it. He was mentioned in dispatches for the second time.

From the 14th to 19th September, Lang, who was one of the very few unwounded R.E. officers, was employed continuously in sapping through houses, courts, and lanes, seizing and fortifying the main buildings in continuous hand-to-hand fighting. On the 19th he aided in the capture of Burn Bastion, and in company with Lieut. F. Roberts, R.A. (afterwards F.M. Lord Roberts), made a reconnaissance up to the Lahore Gate, which led to its capture the next day.

On the 20th he was with the 60th Rifles at the capture of the Palace when Lieut. Home, R.E., blew in the gates. On the 24th September Lieut. Lang marched from Delhi with a column sent to clear the Doabs and reach Cawnpore, and was present at the actions at Bulandshahr and Aligarh, and at the demolition of Malagarh Fort, where he was blown down by the explosion which killed Lieut. Duncan Home, who had been promised the V.C. for his exploit in blowing in the Kashmir Gate at Delhi.

On 10th October he was also present at the Battle of Agra, where he had several hand-to-hand combats, and was for the third time mentioned in dispatches.

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At Cawnpore he joined the army under Sir Colin Campbell, marched to Lucknow and served throughout the "relief." Here he was among the first at the storming of the Sikandarbagh, where he was knocked down by a bullet and bruised, though not wounded, and was also with the 93rd Highlanders at the capture of the Shah Najaf. At the capture of the Mess House he was ordered, with Lieut. Forbes, to blow in the gate, and was promised the Victoria Cross personally by Sir Colin Campbell. He crossed the moat with explosives, but, as he afterwards said, unfortunately (!) there was no opposition.

After his return from Lucknow, on 6th December, he was present at the Battle of Cawnpore, and then served with Walpole's Brigade in minor actions in the Doab. In January, 1858, he was employed on the defences of Futtegurh Fort.

In February and March, 1858, Lieut. Lang served throughout all the operations of the Siege and Capture of Lucknow under Sir Colin Campbell, taking part in the assault and capture of many important positions including the Imambara and Kaisarbagh.

Among his plucky acts here was a daring reconnaissance (in company with Lieuts. Medley, R.E., and Carnegie, R.E.) of Kadam Rasul and the Shah Najaf. These places were found to be abandoned, enabling a considerable advance to be made without opposition and loss. Application was again made for a V.C. with the same answer as on the first occasion. Lieut. Lang was for the fourth time mentioned in dispatches.

After the Capture of Lucknow he served with Sir Hope Grant's Column in Oudh, including the action at Baree, etc., till he was recalled to Lucknow for employment in housing the large army quartered there in 1858.

So ended Arthur Lang's work on active service, which has been narrated in as much detail as is permissible in this short memoir, in order to show the energy and fearlessness of his nature. A young man of fine stature and splendid physique, he had been captain of the cricket and football teams at Addiscombe, and in the stress of war was always foremost in deeds of daring, courage and endurance.

For his services in the Mutiny he received the medal with three clasps; and there can be no doubt that the C.B. which was only awarded to him in 1908, when he was in his 76th year, was thoroughly well earned.

After these events he was appointed Assistant to the Chief Engineer of Oudh, and Executive Engineer, 3rd grade, in July, 1859. After transfer to the Punjab (Umballa) in January, 1861, he was promoted Captain in March, 1862, and to the 2nd grade in the following June. In 1863 he was appointed to the Hill Roads Division, Simla, and transferred to Oudh in 1865 as Assistant Secretary to the Chief Commissioner of Oudh. Promoted to the 1st grade later in that year

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he became Chief Engineer and Secretary. When making the road from Simla into Thibet, to open up traffic with China, the path had to be carried in places along the face of vertical cliffs in gorges thousands of feet deep. The only way of tackling this was to sling native workmen over from the tops of the almost inaccessible rocky scarps, who would jump holes in the face of the cliff, and fix steel jumpers or crowbars at the proper levels and distances, using them to support wooden platforms from which blasting operations could be undertaken. Gradually in this way a narrow roadway was worked out in the cliff. It required a good head to superintend all this overhanging work, and no better man than Arthur Lang could have been found for the job.

In 1871 Capt. Lang was appointed to officiate as Principal of the Thomason Civil Engineering College, Roorkee. Promoted to Major in 1872, he was made permanent Principal of the College in 1873 and held the appointment till May, 1877. On his return from furlough in 1879 Lieut.-Colonel Lang was posted to the Military Works branch and was placed in charge of the Fortification Branch at Headquarters, Simla. One who worked under him there says, "As a young subaltern I was much struck by his strict control combined with encouraging urbanity and consideration for juniors. His knowledge of the art of fortification and details connected therewith was vast, and under his superintendence a number of valuable projects were prepared. Out of office his kindliness and friendliness were marked, and the hospitality of his house was unbounded."

Lieut.-Colonel Lang was next appointed Superintending Engineer and Secretary to the Agent to the Governor-General, Beluchistan, and took up his duties in February, 1881, at Sibi. In October of the same year he was promoted Brevet Colonel, and in January, 1883, was appointed to officiate as Chief Engineer and Secretary to the Chief Commissioner, British Burma, at Rangoon, where, as the province was somewhat disturbed at the time, a really good man was wanted. On his advancement to Chief Engineer, Class II., he was appointed to the Local Government North-West Provinces in April, 1885; but as he had been nominated C.R.E. of 1st Army Corps he was directed to remain pending further orders in Burma. He arrived at Naini Tal, N.W.P., in July and was promoted Chief Engineer, Class I.

He was permitted to retire on the maximum pension on 1st December, 1888. Thus ended a long and distinguished career in his country's service.

This notice of the public career of Colonel Arthur M. Lang would be far from complete without an appreciation of his personal character. Strong and full of fiery bravery, as we have seen, he was at the same time gentle and modest—his was a nature to avoid and dislike publicity. He was always active and athletic, and when Principal of the Roorkee College he interested himself

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in the games of the students, often playing football with them, and encouraged that side of their education almost as much as their study of the various sciences connected with engineering. His intellect was keen and unclouded to the last, and his all-round general knowledge most remarkable. There were few subjects of which he was not a master, and yet he never obtruded his knowledge. He was well-known as an authority in the entomological world, and made a collection of Himalayan and other Indian butterflies and moths, among which were specimens previously unknown. The collection is now in the keeping of the Calcutta Museum. In his later years he took great delight in the cultivation of flowers, and it was an education to talk to him on the subject. A man of charming and frank manners, he possessed the ease, tact and consideration for others which mark the true gentleman. When it is added that he was an earnest and sincere Christian, it will be readily understood that to know him was to admire and love his noble character.

He was married three times and leaves a widow and nine children—three sons (all in the Army) and six daughters. He died at Guildford, where he had lived for many years after his retirement, worshipped by his family and beloved by a wide circle of friends.

J.W.S.

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REVIEW.

THE YEAR-BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY, 1916.

A SHORT notice of this volume has already appeared in the *R.E. Journal* for July, 1916, in which a brief summary is given of the contents of this, the fourth number, of the *Year-Book*. The contents of the volume are of considerable importance and deserve fuller mention than it was possible to include in the short notice referred to above; in consequence, a further review has been prepared of those portions of the *Year-Book* which are of special interest to the general reader. The volume begins with a very useful historical summary under the heading of "Record of the Development of Wireless Telegraphy." From it we learn that although 47 years elapsed (1840 to 1887) between the date when Joseph Henry first produced high-frequency electric oscillations and the date when the brilliant experimenter Heinrich Hertz discovered the progressive propagation of electro-magnetic action through space, yet in less than 10 years from the date of Hertz's discovery Marconi was already in the field with his application for the first British patent for wireless telegraphy (2nd June, 1896), and only six years later he was able to receive readable messages at a distance of 1,551½ miles (on board s.s. *Philadelphia*, in February, 1902). The latest success in the wireless field recorded in the *Year-Book* is the fact that on 28th September, 1915, the American Telephone and Telegraph Company, working in conjunction with the Western Electric Company, succeeded in telephoning by wireless across the American Continent from Arlington to Hawaii, a distance of nearly 5,000 miles. The rapid progress wireless telegraphy has made since 1896 can to some extent be gauged by scanning the lists of Land and Ship Stations given in the *Year-Book*; the former occupy 57 pages, whilst the latter occupy 137 pages of the volume. Of the Land Stations, three are stated to have a normal day range exceeding 2,000 nautical miles, *i.e.*, Glace Bay (3,125 nautical miles), S. Francisco (2,500 nautical miles), and Hawaii (2,500 nautical miles), whilst a couple of dozen of the Ship Stations in the list are stated to have a normal day range of at least 500 nautical miles. The night range of three dozen of the Ship Stations exceeds 1,000 nautical miles, three of them being stated to have a range as high as 1,500 nautical miles.

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An article on "Intelligence in Naval Warfare" is contributed by Mr. Archibald Hurd. In it he traces the development of the Signal Service in the British Navy and compares the conditions which existed with regard to this service in Nelson's times with those which prevail to-day. "Probably few of those who are watching the progress of events in the greatest naval war in the history of the world," says Mr. Hurd, "realize fully the changed conditions, particularly in respect of intelligence, under which hostilities are being conducted. At the time of the last great war the system of signals employed at sea, and only recently introduced, was crude, and was regarded with suspicion and mistrust by many senior officers, while the Board of Admiralty can hardly be said to have possessed what we should regard as an intelligence department." It was not till 1805 that Lord Barham, on becoming First Lord of the Admiralty, constituted himself practically Director of Intelligence, yet during the ten years preceding this date an almost uninterrupted war at sea had been in progress. The only swift means of communication between the Admiralty and the ports at this time was the post-horse, supplemented by the recently developed semaphore system, and the orders of the Admiralty had to be conveyed from British shores to vessels at sea by small, swift sailing ships. Mr. Hurd remarks: "Fortunately, though means of communication were slow, the movements of ships were far slower. . . . The success with which communications were maintained between the Admiralty Board in London and the fleets engaged in hostilities in far distant theatres of war constitutes no mean tribute to the organizing ability and mental powers of the officers of those days." At the period of the Great War, the wonder of the age was the semaphore, the invention of an Englishman named Edgeworth. This method of communication was in 1794 already in use in France as a means of communication between that capital and the French armies on the frontier—its use spread to other parts of the Continent of Europe shortly after. "In the late years of the eighteenth century," Mr. Hurd tells us, "a series of semaphore stations was established, connecting the Admiralty in London with the officers commanding at Portsmouth, Plymouth and Deal. High points at short intervals were selected for the construction of semaphore towers." The sites of many of these towers, marked "Telegraph," are shown on Ordnance maps of a century ago. The signalling apparatus at first consisted of six shutters arranged in two frames; later Sir Home Popham brought into use the familiar mast with two arms. Under favourable circumstances the Greenwich Time signal could, it is stated, be passed to Portsmouth and an acknowledgment received in less than one minute. But the semaphore could obviously only be used for short and simple messages, and the Lords of the Admiralty had to rely upon post-horses to a large extent in order to obtain despatches from the officers at sea.

"The signalling arrangements between the naval authorities ashore and the officers at sea were," Mr. Hurd tells us, "not less rudimentary than the means of communication between ship and ship, as signals were passed

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under great difficulties." We learn from the synopsis of flag signalling given by Commander Robinson in his "British Fleet" that flag signals were employed in the English service in the thirteenth century. The early system was complicated and unwieldy; however, it remained in use till the close of the American War. It was replaced in 1792–3 by the two codes, known as Lord Howe's signals, which were themselves superseded by Popham's code at the urgent request of Nelson himself, just prior to the eve of Trafalgar. The credit for the development of naval signalling, as it is known to-day, must, however, be given to Kempenfelt, the great pioneer, who persevered in his task of providing the Navy with a system of flag signalling, in spite of the bitter opposition of his brother officers, until success was attained.

Mr. Hurd refers to the momentous change in methods of communication which has been brought about by the invention of wireless telegraphy. He recalls that Barham, in his day, was hesitating as to the wisdom of employing flag signals at sea and contrasts the position in which this great sailor was with regard to communication services when First Lord of the Admiralty with that of the occupant of this office at the outbreak of the present War. Writing of Barham, Mr. Hurd says: "He would be dumb with amazement at the statement that in the opening days of the War the Germans, by a wireless message from a home station, had been able to send a message into the farthest recesses even of the Pacific Ocean, warning merchant vessels to proceed at once to the nearest neutral port, in order to avoid capture." The warning referred to enabled German owners to save 80 per cent. of the shipping belonging to them from capture or destruction. Attention is also drawn by Mr. Hurd to the facilities which wireless telegraphy places at the disposal for maintaining communication between the Board of Admiralty and the Admirals commanding at sea, and between the various components of the Grand Fleet itself.

The second article in the *Year-Book* deals with the very interesting subject of "Photo-Electric Phenomena" and is contributed by Professor J. A. Fleming, F.R.S. Light and electricity, as is now well known, are very closely connected together, and since Hertz first noticed, in the course of his celebrated researches in the production of electric waves, that the discharge in the form of an electric spark between two balls is facilitated when light from another spark falls upon them, many physicists have turned their attention to the investigation of photo-electric phenomena. The use of the term photo-electricity, it should be noted, is restricted to the description of the particular effects which are connected with the power of light of certain kinds to cause an electric discharge or leakage of electricity from certain substances, and also, under some conditions, to produce an electric charge, or electromotive force or ionization.

It has been established by experiment that ultra-violet light facilitates the discharge of negatively electrified metal balls and zinc plates; it has also been found that if the zinc plates are oxidized or tarnished, or have

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been long exposed to the air since polishing, then the discharge of negative electricity from them proceeds much more slowly. If the plates are positively electrified the discharge does not take place or does so very slightly.

In his article, Professor Fleming gives a description of special forms of apparatus—some of them devised by himself—used to obtain the effects described above.

The consideration of the effects observed during experiments show that there is a leakage of negative electricity from negatively electrified bodies when they are exposed to light, chiefly ultra-violet light. That is to say—in modern terminology—light falling on certain substances causes an escape of electrons from them.

The times taken by various substances, solid, liquid or in powder to get rid of their negative charges can be ascertained by suitable experiments—these are described by Professor Fleming—and data can thus be obtained for comparing them with each other with regard to their photo-electric activity in air. Caution, however, must be exercised in interpreting the results of the observations in air; the radiation most effective in the case of one metal or substance is not so in another, and, moreover, the nature of the surrounding atmosphere affects the result. Account has also to be taken of a very noticeable effect, commonly referred to as *photo-electric fatigue*, which consists in a rapid decrease of the photo-electric sensitiveness of a freshly-cleaned surface of metal if left exposed to the air. As the photo-electric sensitiveness is not recovered on resting, Professor Fleming suggests that *photo-electric deterioration* would be a more appropriate term for describing the falling off in sensitiveness.

Photo-electric deterioration seems to be due to a peculiar condition of the gaseous layer adhering to the surface of bodies; however, further research is necessary to clear up the matter.

Experiments indicate that pure, clean metal surfaces in a very high vacuum suffer no photo-electric deterioration. Professor Fleming describes experiments carried out, in exhausted tubes, with liquid potassium sodium alloy, which is very highly photo-electric, and, moreover, sensitive to ordinary visible light. Under suitable conditions the following facts can be observed, namely:—

(*a*). That the alloy surface rapidly discharges negative electricity when light from an arc lamp falls on it.

(*b*). That when illuminated the alloy discharges positive electricity.

(*c*). That the alloy when illuminated actually generates an electric current, proving that light causes an emission of negative electrons from the alloy surface.

In the latter case the photo-electric current varies with the colour of the light thrown upon it, *i.e.* with the wave length. It is pointed out that: "If it were possible to obtain the rare metal rubidium in large quantities, it would be possible to construct a rubidium photo-electric battery of a large number of cells, which would create a considerable electric current merely by illuminating the rubidium surface." In this

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case the energy represented by this current would, it is needless to say, be drawn from the light energy.

Mention is next made of the photo-electric properties of various classes of substances, solid and liquid, and it is pointed out that there is a certain connection between fluorescence, phosphorescence and photo-electric leak or discharge. Broadly speaking, the fact that a substance is fluorescent is generally an indication that it is photo-electric and will lose negative electricity when illuminated by ultra-violet light.

Professor Fleming gives in outline the explanations which have been offered to account for photo-electric effects. These explanations are based on the modern view that electricity possesses an atomic structure, the atoms of negative electricity, called electrons, being regarded as constituents of chemical atoms.

To put it very briefly, it appears clear from investigations which have been made that photo-electric sensitiveness is not an atomic property, but a molecular one, and depends also on molecular grouping. Accordingly it has been assumed that there are in connection with certain molecules or groupings of atoms certain electrons which can be set free by light of short wave length. A certain energy is required to get the electron away from its atom or to detach it from home. The ordinary undulatory theory cannot, taken by itself, adequately explain photo-electric effects, and, consequently, it has been necessary to introduce modifications. For instance, Sir Joseph Thomson has suggested that luminous energy is concentrated at certain points on the wave front, whilst according to the more recent hypothesis developed by Planck, Einstein and others, it would appear that the radiation is not emitted continuously, but in gushes or bundles—called *quanta*. This view of the case gives to the radiant energy an atomic character, and the *quanta* can be spoken of as atoms of energy. Although this quantum theory helps to explain photo-electric effects, and also many other matters, very easily and has attracted much attention, yet leading physicists have felt that it does not provide a final theory and that photo-electric phenomena are still not yet fully explained.

Photo-electric effects in the cases of gases are next considered, and particularly the circumstances under which light of short wave length can ionize gases or produce in them positively and negatively electrified particles. Experiments show that ultra-violet light of very short wave length can ionize gases, and it has also been proved that there is a connection between the length of the longest wave of light which can effect this ionization and the ionizing voltage. The product of this longest wave length and the voltage is always a number near to 11,000 or 12,000—the wave length being measured in Angstrom Units. Experiments carried out, with suitable precautions, prove that light of wave length less than about 1,400 Angstrom Units can ionize, *i.e.* can produce positive and negative ions in a gas. Since the sun has a very high temperature, it must certainly radiate light of very short wave length, but it has been established that the light which reaches the surface of the earth from the sun and stars contains no wave length shorter than about

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2,950 Angstrom Units. It would therefore seem that there is an absorption of ultra-violet light of very short wave length in the upper levels of the atmosphere. There are well-known phenomena in connection with wireless telegraphy which seem to indicate the existence of somewhat strong ionization in the upper levels of our atmosphere which, in part at least, must be due to ionization by solar light, since the condition of the atmosphere in this respect varies by day and night. Professor Fleming points out that, roughly speaking, there are three layers in the earth's atmosphere, not, however, sharply delimited from each other, in which ionization occurs. In the upper or highest layers of the atmosphere there is a strong permanent ionization with a predominance of negative ions; in the middle layers there is ionization, both positive and negative; and in the lower layers near the earth there is weak ionization. The refractive index of ionized air for long electric waves has been proved experimentally to vary with the degree of ionization, and this may explain some of the curious variations in the strength of radio-telegraph signals observed at or about sunrise or sunset and the extension of range of freak signals observed at other times by the refraction or bending downwards of the electric rays. There are good grounds therefore for believing that atmospheric photo-electric effects play a very important part in long-distance wireless telegraphy. Further research, however, is necessary before all these phenomena can be disentangled and explained.

The third article, entitled "The Allies' Strategy in 1915," is contributed to the *Year-Book* by Colonel F. N. Maude, and he deals at length with the plans of the Allies' Campaigns in the Western and Eastern Theatres and in Poland.

Colonel Maude concludes with a brief reference to the great part wireless telegraphy has been playing in the War. He points out that "Within the territories of the Central Powers the existing telegraphic facilities were already so complete that the General Staff could probably have handled their armies nearly as well without its aid. The Allies, on the other hand, during the last six months could hardly have co-ordinated their movements lacking its aid. . . ." "Similarly at sea. Whereas the Germans have had little opportunity of availing themselves of wireless communication between headquarters in the Kiel Canal and their ocean outposts, the maintenance of our blockade services, under the new conditions imported into naval warfare by the submarine, would have been very nearly impossible without wireless telegraphy."

The fourth article of the series is entitled "Capacitance, Inductance, and Wave Length of Antenna," and is contributed by Dr. W. H. Eccles, D.SC.

Dr. Eccles tells us that "The main purpose of this article is to call attention to the fact that a knowledge of the wave length of an antenna is, from the practical as well as the experimental aspects of wireless telegraphy, of greater importance than a knowledge of the electrostatic capacitance or the steady current inductance."

It is pointed out that in the matter of the so-called electrostatic

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capacitance of an antenna indefiniteness is introduced by the want of precision concerning the position of the bottom end of the antenna relative to the earth. Again, so many variable factors affect the electrostatic capacitance of an antenna, such as the existence of conductors or partial conductors in its neighbourhood, that the measured or calculated electrostatic capacitance is of little value when dealing with problems connected with oscillations in an antenna.

Similarly with regard to the inductance of an antenna, although its approximate value may be obtained by calculation, it must be borne in mind that the steady current inductance is never equal to the effective inductance and therefore ought not to be used in radio work.

Dr. Eccles remarks that "The whole position can be summed up in the statement that in the case of the antenna of radio-telegraphy the capacitance and the inductance are distributed; and not only is this true of the antenna wires, but also of neighbouring conductors such as the earth, the masts and the stays, with the result that the effective inductance and capacitance depend greatly on the frequency and cannot be confidently calculated from steady state values." In consequence, it is urged that the natural wave length of the unloaded antenna should always be used for the following reasons :—

(i.). There is no indefiniteness about the term itself or about the circumstances in which the antenna must be put for measurement—the antenna must be connected to its normal earth.

(ii.). The phenomenon of variation of the antenna characteristic does not enter, since the natural wave length of a particular aerial is necessarily associated with a fixed frequency.

(iii.). The neighbourhood of other conductors, permanent or temporary, good conductors or partial conductors, has, in general, insignificant effect.

Further, the natural wave length of an antenna is generally more easily and more accurately calculated than is the steady capacity or inductance. Experiments carried out by Dr. Eccles tend to show that the value of the natural wave length of an unloaded antenna is equal to the length of the antenna multiplied by 4·20. The natural wave length of an antenna can be readily measured with the aid of a wave metre and buzzer.

Dr. Eccles draws attention to the fact that in the early days of wireless telegraphy, when plain aerial sending was the rule, the natural wave length was the customary electrical datum. But, when inductance was inserted in aerials to increase the wave length of the radiation, the notion of measuring the electrostatic capacitance was introduced in order to facilitate the calculation of the new wave length. However, difficulties in connection with these calculations can, it is pointed out, be overcome by the use of simple graphical charts. Five charts of the kind referred to are given in the article and a few examples are worked out to illustrate their use.

A general survey of war happenings affecting radio-telegraphy is provided in an article by Mr. H. J. B. Ward entitled "Wireless Waves in the World's War."

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The first step of importance taken in connection with the present War was undoubtedly that connected with the recall in the early hours of 30th July, 1914, of the first fleet which had just left Portland and was about to disperse for manœuvre leave; in this matter wireless telegraphy played an indispensable part. Three days later, *i.e.*, two days before the outbreak of hostilities, the British Government took steps to assume complete control of all means of wireless communication throughout the British Isles and its territorial waters, thus rendering it possible to establish a strict censorship on all communications between the British Isles and all foreign countries.

The matter of dealing with wireless outside the British Empire has presented many difficult problems. In the case of the enemy installations either destruction, or capture and retention, have been the only effective courses open to us. In neutral countries, however, the situation has been complicated owing to (*a*) the various interpretations put upon neutrality by the governments of the different countries; (*b*) the amount of influence obtained in peace time by the German Government through their state-aided pseudo-private erection of stations; and (*c*) the amount of control exercised by the responsible neutral governments over outlying portions of their territories.

The attitude of all the *Governments*, it is stated, has been most correct throughout; the difficulties which have been experienced have been due to the surreptitious influence exerted by Germany rather than to the official attitude of neutral governments. An incident of this kind is referred to in the *Year-Book* in connection with the erection of a base of supplies and a radio-telegraphic signalling station at Easter Island, which is under the jurisdiction of Chili.

Attention is called to the report of a member of one of the naval expeditions engaged in "rounding up" the German Pacific Colonies, in which special emphasis is laid on the fact that wireless installations were constantly being found in isolated and out-of-the-way places—in some cases 50 miles from the coast—artfully concealed amongst trees. This is but one example out of many of the cunning exercised by Germany in pursuing her policy of secret world-wide wireless.

Brief references are made in the article under review, *inter alia*, to Enemy Wireless in the Field, British Field Radio Activities, Wireless on Aircraft, Wireless in the "Senior Service," the Naval "Nerve Centre," Enemy Naval Wireless, and Wireless in the Mercantile Marine.

Perhaps one of the most striking points in connection with wireless which has been developed by this war lies in the fact that much of the official information—particularly enemy information—has been brought to the notice of newspaper readers through this medium.

In an article dealing with "The Progress of Radio-Telephony in the U.S.A. during 1915" mention is made of the fact that on 21st October, 1915, "radio-telephonic messages, emanating from Arlington, were heard in radio receivers at San Francisco, California, Pearl Harbour, Hawaii, and Eiffel Tower, Paris, France." The results achieved out-distance anything heretofore accomplished. Without Professor Fleming's

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vacuum valve it would be impossible to telephone any such distances as indicated; it is the keystone of the arch on which these successes in wireless telephony have been built.

Among other articles of interest included in this number of the *Year-Book* are the Report of the Committee appointed by the British Association for carrying out radio-telegraphic investigations, articles on the "Measurement of Signal Intensity," "The Problems of Interference," and "Long Distance Services": the last of these gives a brief outline of progress up to date in the wireless field.

W. A. J. O'MEARA.

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NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

No. 7.—July, 1916.

THE BELGIAN ARMY IN THE FIELD.

Composition of the Belgian Army at the Beginning of the War.

The article on the above subject begun in the June number of the *Revue* (*vide R.E. Journal* for September) is concluded in the number of this publication now under review.

At the time Germany violated the neutrality of Belgium, the Belgian Army was undergoing reorganization in accordance with the provisions of the recent law on the subject which came into force eight months before the declaration of war. Nevertheless, the mobilization of the Belgian Army was carried out with surprising rapidity—it was ordered at 8 p.m. on 31st July, 1914, and was completed before midnight of the 4th August following. On the evening of the date last mentioned the Belgian Army was already on the move, so that when the German Army entered Belgium, on this date, simultaneously with the declaration of war, it ran up against King Albert's Army and found itself too late to prevent the mobilization of the Belgians, to the great disappointment, no doubt, of the German Great General Staff.

The Belgian Army at this time consisted of 120,000 trained and embodied men (these were practically all between 20 and 36 years of age). During the short space of time which elapsed between the declaration of war and the actual invasion of Belgium 45,000 Belgians offered to join the Army as volunteers, but only about one half of them could be accepted.

A detail of the organization of the Belgian Army is given in the article under review. This information has already appeared in a review of the part played by the Belgian Army in the operations of 1914, which appeared in the *R.E. Journal* for November, 1915, and is therefore not repeated here. Since the outbreak of the War, many modifications have been made in the original organization of the Belgian Army; some of these have been necessitated by the heavy casualties suffered, others in order to meet the needs of the tactical situation. As is well known, the outstanding feature of the present war is the great demand made on the technical branches of the armies, and King Albert's Army, as well as those of the other belligerents, have brought special units into existence to meet the needs of the situation. Large numbers of Belgians have also been employed in the workshops and arsenals of France in connection with the manufacture of munitions of war, and some of the novel appliances in use in France and Flanders to-day are the inventions of Belgians.

When the War began the Belgian Army had but one 75 mm. gun

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in its possession, and this had a comparatively short range. To-day the Belgian Artillery is plentifully supplied with excellent long-range guns of large as well as of small calibre. Great developments have also taken place in the matter of the provision of machine guns.

Considerable attention has also been given to aviation, and Belgian aviators are constantly engaged on long and short distance raids into the territory occupied by the German invaders.

The uniform of the Belgian Army also has undergone a complete transformation. The old uniform has been completely discarded and one of a serviceable design, brown-grey in colour, has taken its place. The colour of this uniform harmonizes with that of the earth and vegetation in Flanders. Belgian soldiers have been provided with steel helmets, with cloth covers of the same colour as their uniform, for use in the trenches.

The Belgian has proved himself a brave soldier. He is not credited with possessing an aggressive spirit or any great enthusiasm for offensive tactics. However, during the present war, Belgian troops have, on several occasions, rushed to the attack with such remarkable courage as to carry positions from which it was thought the enemy could not be driven back. The surprises of the War, such as the 16½-in. howitzer fire and the use of poisonous gases, have not disturbed the *morale* of the Belgian soldier. Speaking generally, the great fault of the Belgian soldier is his lack of discipline; this is no doubt due to the spirit of independence which is a characteristic of the Belgian people as a whole.

The author of the *Revue* article is of opinion that during the progress of the War, Belgium has got over the difficulties of her military crisis in a most skilful way. From this intense trial her army comes out reformed, strengthened, regenerated. In fulfilling its mission with heroism and success, the Belgian Army has been transformed into a perfect modern fighting machine.

If an explanation is required of the causes which have moved Belgium to accomplish so much, it must be sought, according to the author of the *Revue* article, in the deep-rooted affection the Belgian has for his fatherland, in his desire for vengeance, fired by the spirit of independence with which he is imbued, in a hatred of those who attempt to deprive him of his liberty. A most serious mistake was, it is said, made by the Powers when they endeavoured to impose an obligatory neutrality on Belgium and undertook to guarantee this neutrality.

MUSKETRY TRAINING OF THE SWISS INFANTRY.

New instructions for the musketry training of Swiss Infantry were approved on the 13th April, 1916: the musketry training scheme, of January, 1908, has in consequence been superseded. The 1908 scheme introduced radical changes in the training programme which had been in force up to that date in the Swiss Army; the principles laid down in the 1908 scheme are in no way altered by the new Musketry Instructions, details of the training programme are alone affected.

No change has been made in the recruits' course. Minor changes have been made in the preparatory target practice course—the so-called *exercices préparatoires*—at short ranges (from 50 to 200 metres) and in connection with the test practice—the so-called *exercice d'essai*—at 300

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metres; in the former case the change affects the class of targets and in the latter the standard of skill required. An important change has been introduced in the recruits' final target practice course—the so-called *exercices principaux*. The part of the old course in which the recruit had to fire in the standing position at the target, known as D, at a range of 300 metres has been abolished, and instead the recruit is required to fire with his elbows resting on a parapet either at the target, known as H, or at a target representing head and shoulders, at a range of 100 metres. He fires six rounds at these targets, and is not allowed the use of any auxiliary sighting appliance; it is not until the whole of these rounds have been fired that the result is signalled. The conditions laid down are intended to represent those of trench warfare.

The former allowance of ammunition of 200 rounds per N.C.O. and recruit and of 100 rounds per officer remains unchanged.

An entirely new course of range practice for young officers has been introduced; it consists in firing 30 rounds at various classes of targets at ranges of 100, 200, 300 and 400 metres, in the prone and standing positions and on the knee.

An increase in the allowance of revolver ammunition has been made. Formerly officers and N.C.O.'s were allowed 48 rounds and the recruit 60 rounds; in both cases these numbers have been increased to 80 rounds of ball and 20 rounds of blank ammunition.

Changes have been introduced in the efficiency badges and in the classification of officers and men in musketry. The writer of the *Revue* article does not approve of the new regulations on the last points referred to; he considers this part of the new scheme to be illogical; otherwise he is satisfied that the new instructions mark progress in the matter of musketry training.

Improvisation of Stretchers out of Shelter Tents.

The manual for the use of the *personnel* of the Sanitary Corps of the Swiss Army provides for the instruction of the men of that corps in the improvisation of stretchers. At Schools of Instruction for men of the Sanitary Corps a part of the training of the *personnel* consists in the construction of emergency stretchers made from articles of military equipment, such as greatcoats, rifles, belts, haversacks, etc.

In the *Revue* article descriptions are given (with illustrations) of the methods in which a shelter tent, consisting of a square of canvas (length of side, 5 ft. 3 in.), can be utilized, with the aid of one or more supporting poles, for improvising a stretcher.

The Three Phases of the Advance in a War of Positions.

The *Revue* article consists of five plates with descriptive matter relating to the diagrams, etc., thereon.

On Plate I. are given (*a*) a section of a fire trench at a loophole and (*b*) a section of a "dug-out" with a protected entrance.

It is pointed out on this plate that the French first line is not one continuous trench. In many sections of defence there is an interval between the trenches—a *zone de combat*—500 yards and more wide, which provides a space for manœuvre during the *first phase* of trench warfare.

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As the works of the belligerents approach nearer to one another the *centres of resistance* increase in number and are connected to one another by a *defensive curtain*. It is from this line of works that saps, which form the approaches and advanced parallels, are pushed out during the *second phase* of trench warfare. In the *third phase*, the advanced parallels of the opposing forces become linked up during the progress of mine warfare.

Plate II. depicts in outline a part of the first line positions prepared by the French and German troops on the Lorraine front at a time when the main body of the opposing forces were separated by a distance varying from 900 to 1,100 yards.

Plate III. depicts the same part of the front as in Plate II. when the French trenches had been pushed to within from 200 to 400 yards of the German main position.

Plate IV. depicts the same part of the front as before when the stage of mine warfare had been reached.

On Plate V. a section is given of the ground between one of the French *centres of resistance* and an enemy advanced parallel to illustrate the progress of trench warfare. On it are shown the positions of the trenches forming the *centre of resistance*, the parallels, and the lines of obstacles between the *centre of resistance* and the enemy's advanced parallel.

NOTES AND NEWS.

Switzerland.—A special contributor calls attention to a pamphlet entitled *Le peuple et l'Armée* by O. Bosshardt which has been recently published in Geneva. The author of the pamphlet has been attached to the Swiss General Staff since the mobilization of the Swiss Army in the autumn of 1914. He has thus been in the position to hear and see many things and particularly, it is said, to notice the differences which, at the present time, are dividing the Swiss people and their army. It is thought that Monsieur Bosshardt has taken too serious a view of the situation; there is no real antagonism between the Swiss people and the Swiss Army. There are unfortunately officers in Switzerland, as elsewhere, who hold extreme views and express them openly, but there are no grounds, it is said, for the view that all Swiss officers hold the opinion that the maintenance of discipline and the spirit of a democracy represent two irreconcilable elements in a State and therefore cannot co-exist. There are, it is true, certain officers who take a pleasure in quarrelling with the civil authorities, but they are not in the majority. Washington required that all his officers should be *gentlemen*. To-day, one cannot, it is said, be so exacting on this point as in the past. Soldiers and civil authorities are often inclined, it is said, to be too touchy; Monsieur Bosshardt recommends both these classes to put their duty to the Army and to the people before all things else.

Switzerland should continue to maintain her traditional policy of neutrality; there should be no parties in the Republic labelled "Interventionist," "Ententophil," or "Germanophil." Every Swiss should do his best to help his Government to maintain peace in the Republic. Switzerland should be in the nature of a beacon to lead ships in a storm to a refuge of safety; in order that this object may be attained her people must be united and her army strong.

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That discussion may not take place on military matters in the National Assembly is something which at first sight causes a shock, but it is well to bear in mind the old adage: "Speech is silvern; silence is golden." There are times when it is one's duty to speak, others when to maintain silence.

United States of America.—A special correspondent refers to the brush of the 13th U.S. Cav. Regiment with a band of Mexican bandits, and also to the preparations which were on foot at the time of writing to send an expedition into Mexico to punish Villa. This correspondent is naturally unable to deal with the details of the Expeditionary Force. It is stated however that difficulties were being experienced, owing to the weakness of the American Army, in getting together a sufficiently large force for the purpose. However, on the 16th March last, Congress passed a resolution for 30,000 additional recruits to be enrolled, in order to bring up the Establishment of the Army to 120,000 men. In consequence, 147 new recruiting offices were opened and kept busy day and night; and striking posters were posted up everywhere *à la mode anglaise.*

Villa's raid has had the result of causing large numbers of men to join the forces, even the National Guard.

The Lines of Communication from the American-Mexican frontier, in the case of an offensive campaign, are likely to have a length of 270 to 280 miles. Preparations are therefore on foot to organize motor-transport supply columns, which will enable communication to be effectively maintained between the supply bases and the troops in the fighting line.

It is said that the 7th New York Regiment (which is part of the State Militia) has shown considerable enterprise and has by private effort provided itself with motor transport. In this respect this regiment is better off than regiments in the Regular Army.

As regards the United States Artillery, the Ordnance Department has since 1903 been carrying out experiments with motor vehicles designed for the use of this arm. In 1915 experiments were carried out at Rock Island and at the artillery ranges at Fort Gill with tractors for drawing guns and ammunition wagons. Tractors were not found suitable for drawing field guns and their ammunition wagons, but in the case of heavy artillery they were found very useful.

The question of army reorganization is again to the front in the United States. The scheme of the War Minister (Mr. Lindsay Garrison) contemplates the provision of (i.) a Reserve which would comprise not only the present reservists of the Regular Army, but also all "old soldiers" under 45 years of age and specialists (doctors, engineers, etc.) willing to serve voluntarily, and (ii.) a "Continental Army," which would be a kind of voluntary militia raised by the Federal Government and not by the several Federal States. It is expected thus to raise 400,000 men, in contingents of 133,000 men per annum. The men in the "Continental Army" would serve three years with the colours, and three years in a "Continental Reserve." It is expected that considerable difficulty will be experienced in recruiting such an army.

A proposal was, at the time of writing, before the Senate for increasing the Peace Establishment of the American Army to 178,000 men and the War Establishment to 250,000 men. The question of federalizing the

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National Guard or Militia comes before the House of Representatives periodically, it has been again raised.

Among the innovations referred to is the organization of machine-gun sections in cavalry regiments and an increase of two batteries in the 4th Regiment of Mountain Artillery.

Attention is also drawn to alleged defects in the Aviation Service.

Portugal.—A special correspondent refers to the difficulties which are being experienced owing to the censorship; he has been obliged owing to the regulations to suspend his periodical contributions to the *Revue.*

A Portuguese Expeditionary Force has occupied the Bay of Kionga. The Portuguese acquired the territory of Kionga, which is situated in the extreme north of the Mozambique littoral in December, 1886, by treaty at the time that Portugal and Germany came to an agreement with regard to their respective spheres of influence in East Africa. In June, 1894, the Governor of German East Africa caused the German flag to be hoisted at a point south of Rovuma, during one of his visits of inspection, in territory belonging to Portugal, and even had the audacity to invite the Portuguese Governor to be present at the ceremony. The Portuguese officials raised a protest at this unwarrantable act and appealed to Great Britain to act as an intermediary to bring about a friendly settlement of the question. The matter was referred to arbitration and on the decision going against Germany, the German Government accused Portugal of encouraging a contraband traffic in firearms with the natives and of having failed to suppress the slave trade. The Portuguese Government had no difficulty in refuting these preposterous allegations; however, in view of the serious risk of military aggression, Portugal sold the territory in dispute to Germany. Under the circumstances, the fact that Portuguese troops have been able to conquer the Kionga territory by force of arms has given considerable satisfaction in Portugal.

INTERNATIONAL NEWS.

The German Note to Switzerland has once more brought into prominence the question of the relations between belligerent States and neutral States. What with the demands of Germany, on the one hand, and the attitude of the Allied Powers in relation to the action which the Republic should take in regard to these demands, on the other, Switzerland finds her position as a neutral somewhat embarrassing.

To the Swiss the conduct of both parties appears somewhat arbitrary, and also contrary to the spirit of treaty obligations. However, there is this difference between the treatment Switzerland is receiving from those who are attempting to pull her in opposite directions; whereas the Allies in no way propose to deprive the Swiss of things essential to their existence, the Germans do not hesitate to threaten that they will deprive them of necessaries of life. The attitude of the Powers can be summed up as follows:—Attitude of Allies: "We do not ask you to take our part against Germany, we only ask you not to make use of our substance for her benefit." Attitude of Germany: "We ask you to take our part against the Allies by procuring their substance for us."

Switzerland has every wish to maintain her traditional neutrality, but in the present circumstances she finds it most difficult to do so.

W. A. J. O'MEARA.

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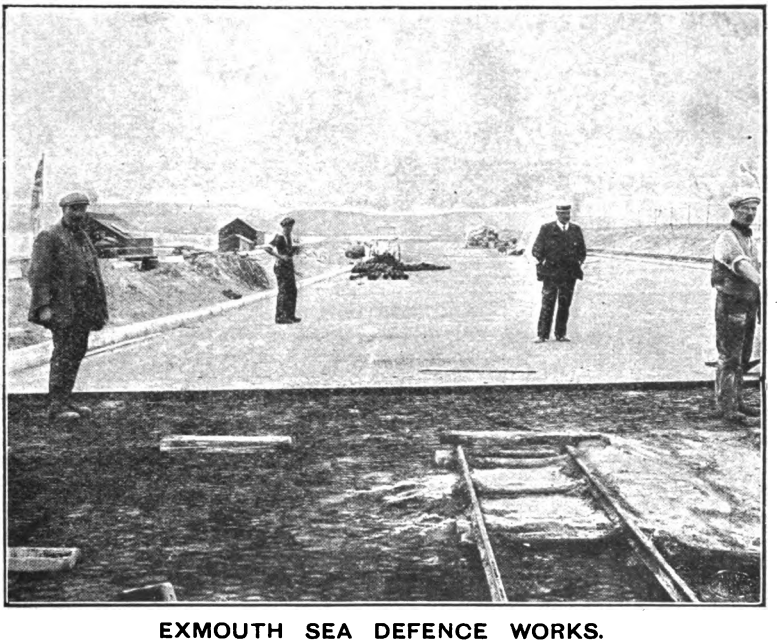

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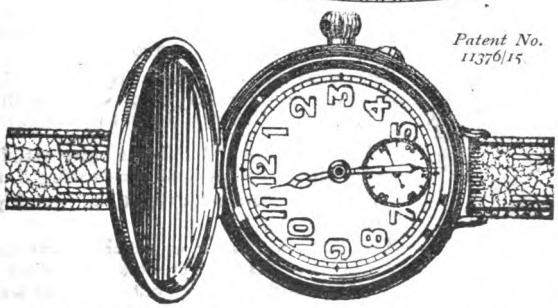

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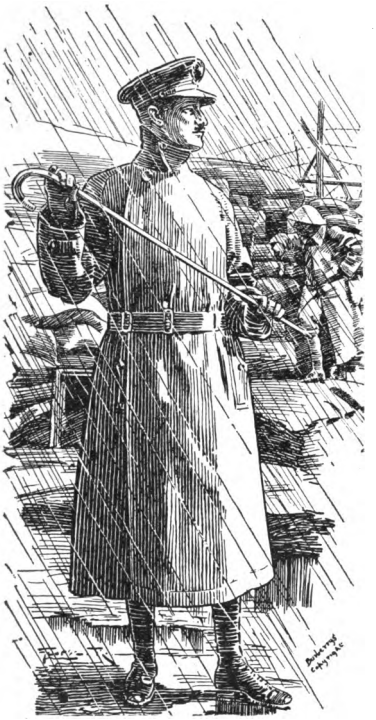

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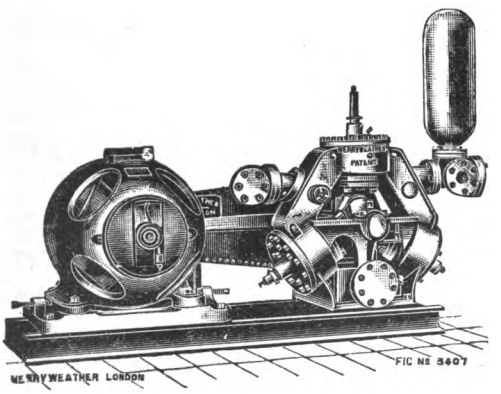

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THE JUNCTION OF THE INDIAN AND RUSSIAN TRIANGULATION WORK IN THE PAMIRS.

[FROM THE RECORDS OF THE SURVEY OF INDIA.]

(*Continued*).

NOTES ON THE GEOLOGY OF THE PAMIRS.

By LIEUT. (NOW CAPTAIN) K. MASON, R.E., *and* CAPT. R. W. G. HINGSTON, I.M.S.

The first thing that strikes one on crossing the Mintaka Pass, is the sudden and marked change from sheer and rugged peaks and deep gorges to comparatively undulating hills and valleys. On either side of the Mintaka Valley, as one descends from the pass, the hills are composed of dark-coloured slates and shales now undergoing rapid denudation, and capped at their summits by a covering of permanent snow. The impression one receives is that the ice-covering has but in recent geological times left the lower slopes of these hills, as the side nalas can be seen in the very commencement of their formation, and are noticeable by the number of talus shoots, slipping down the mountain side. There is one large shoot which has reached such a size, and has extended so far across the valley, as to have completely diverted the stream from its original course. Looking down on this shoot from above, one is struck by the curious wave-like ripples of the surface, which give the idea of a *flow* and seem to indicate that the mass is creeping downwards.

In this valley, as all over the Taghdumbash, the extreme regularity of the way in which the country has been carved by glacial action is remarkable. Sir Thomas Holdich writes of the Sarikōl Range that "Glacial action has had the effect of wearing the buttresses of this range into an almost architecturally regular succession of gigantic square-cut spurs, each facing the plain with a broad triangular-shaped abutment and each pair in succession embracing a glacier."*

This is true of the Northern Karakoram Range and its spurs. Glacial action could alone have produced this uniformity, and the comparative absence of the denuding effects of rain and rivers, which must have been in force since glaciation retreated, seems to indicate that this retreat is of a tolerably recent date. In fact, the whole Taghdumbash Pamir and its surrounding mountains appear to have been in modern geological times completely covered with an immense ice-cap somewhat similar to the Greenland and Spitzbergen of the present day. This ice-cap was the feeder of the huge

* *Report on the Proceedings of the Pamir Boundary Commission*, 1896, p. 39.

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main glacier of the Karachukor or Tashkurghān River, and it has now retreated to the summits of the highest mountains.

Further evidence of glaciation exists all over the Pamir in the form of old moraines, some of which are enormous, and are composed mainly of facetted granite blocks varying in size from pebbles to huge boulders, and hidden under a scanty layer of soft alluvium which in places is covered with a thin saline efflorescence.

These moraines in places give an extraordinarily false impression. Close to the junction of the Kilik and Karachukor Rivers they appear in the form of a series of terraces rising one above another at regular intervals and reaching hundreds of feet up the mountain side. In one place we counted as many as 12 of these terraces, which at first appeared to be the ancient beds of the river before it had cut its course down to the present level. But on closer examination we were surprised to find that these terraces were composed to a large extent of huge granite boulders, polished and facetted, and showing no signs of having been *rolled* into their present position by water action, nor any regularity in their deposition. They are without doubt the products of glacial action and must have been left in the form of terraced moraines by an enormous glacier at regular intervals during its retreat.

One can conceive the whole valley filled with a large glacier and the hills bordering it covered with a glacial cap. Should a *permanent* change of climate occur, and it become warmer with a diminution of snowfall, the glacier would necessarily retreat. After the climatological cycle is complete, one can again conceive the glacier as tending to re-advance, but owing to the *permanent* change in climate, the *secular* advance is more or less balanced by the *permanent* tendency to retreat, and the glacier either remains stationary, or else slowly advances or retreats, leaving lateral and perhaps terminal moraines. After the period for advance of the glacier (during which it has remained practically stationary), the secular period of its retreat begins, and in this retreat it is again aided by the permanent change in climate; the glacier rapidly retreats leaving no moraine, until the semi-cycle of retreat is complete, when for a period the glacier again becomes practically stationary, and again deposits moraine. In this way, by a permanent general change of climate and a succession of secular variations of the glacier, these terraced moraines may be explained. And their remarkable regularity in size seems to indicate periodicity.

The great majority of peaks and ridges over 18,000 ft. are still ice-capped, and on the northern and eastern slopes this cap generally extends down in the form of a hanging glacier or field of névé, terminating in an impassable icefall, which in the distance gives it the appearance of clotted cream pouring over the lip of a jug.

Many of the hills, especially those spurs ascended on the northern

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side of the Pamirs, were composed of granite, and it is probable that owing to the more direct nature of the sun's rays on the southward-facing slopes, the ice-covering was here removed earlier than on the northward-facing ones and that the denudation of the deposits here is practically complete.

Careful search was made for fossils amongst the shale, but none were found. The dip of the slates measured on Mintaka h.s. was 70° W.S.W., but this was by no means constant, and on Kilik East h.s. it would vary between 30° and 70°. It seems curious that these slates should have, on what appears to be the northern slopes of the granite range of the Northern Karakoram, a tendency to dip to the south, but the extreme irregularity of this dip may indicate that they have suffered from later compressions and contortions since the elevation of the range, or that the whole has been inverted to the N.E. This again would be a curious feature as most of the great anticlines of the south are inverted to the south.

EXAMINATION OF CERTAIN GLACIER SNOUTS OF HUNZA AND NAGAR.

By LIEUT. (NOW CAPTAIN) K. MASON, R.E.

The Minapin Glacier (*Nagar*). (*Observed 20th May*, 1913).—This glacier was observed by Mr. H. H. Hayden, Director of the Geological Survey of India in 1906, and his sketch map and report taken as the basis of observation. The new position is shown in sketch.

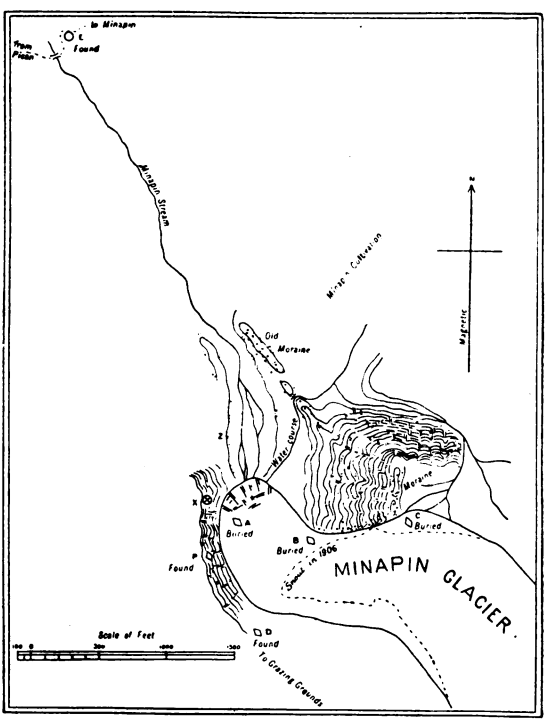

Chart showing the Advance of the MINAPIN GLACIER between 1906 and 1913.

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As will be seen from this, the glacier has advanced about 700 ft. since 1906, and appears now to be heading due north, after having piled and banked up an immense pack of black ice, down which rocks are constantly falling. The snout now falls rapidly with a series of minor transverse crevasses and there are no surface streams.

As regards 1906 marks; A is buried by the advancing ice, and B and C are also covered. E, P, and D, were all found and made use of; a photograph was taken from E according to Mr. Hayden's suggestion for comparison with his.

There is no sign of any terminal moraine and it may be that the glacier is still advancing, or that the torrent is carrying away the débris. The upper part still agrees exactly with Mr. Hayden's description and its icefall remains in the same position, and appears to have very similar features.

A cross was cut at X (see sketch) above the snout on the left side and painted $\overset{X}{\underset{\oplus}{13}}$ in black. Bearings to the snout:—from P, 24°; from X, 61°; from E, 158°. X is beside the same path leading to the summer grazing grounds mentioned by Mr. Hayden. The bearing from E to X is 163°. There were no signs of any of Mr. Hayden's cairns, which have probably been swept away by snow, but the paint had remained in fairly good condition. Mr. Hayden's marks were all repainted with black enamel.

The Hassanabad Glacier (Hunza). (Observed 20th May, 1913).—This glacier was also measured and marked by Mr. Hayden in 1906. On the 20th May, 1913, the snout appeared in practically the same position. Of Mr. Hayden's marks—"2" was easily visible on the granite-veined cliff east of the glacier and could be read through field glasses, from "3." The latter mark has apparently slipped some 50 ft. down the hillside and is now a little below the Garukin irrigation channel. A photograph was taken from here which gives a precisely similar position of the snout to Mr. Hayden's. Mr. Hayden's mark "1" has been carried away and lost down the slope. Station "3," described by Mr. Hayden as "near the last (most northerly) group of bushes" is now slightly incorrect, as a few more bushes have sprung up along the channel to the north. But the position of the boulder is fairly well known, and should serve as an excellent position for photographic comparisons at some future date. Mr. Hayden's marks "2" and "3" were repainted in black.

Mr. Hunter Workman visited the snout of this glacier in 1908, and found that the glacier had remained stationary since 1906, and it may be safely assumed that there has been no advance or retreat since that date.

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THE SASAINI GLACIER.

Little Gujhal (Hunza). (Observed 25th May, 1913).—This glacier feeds the Hunza River from the west about 2½ miles north of the village of Gulmit and just south of the village of Sasaini.

The snout approaches to within about 300 yards of the left bank of the Hunza River. There is a small ice-cave at the snout, and the ground is littered with massive blocks of black ice, much intermingled with boulders and débris. There are several moraines, impossible to distinguish from one another, and it is even impossible to say of many of them whether they are laterally or terminally formed.

At the present time the north side of the glacier (left bank) is bunded up against a well-marked lateral moraine, and towards the village of Sasaini there are several old lateral moraines, which tend to show that the glacier at one time met the Hunza River further north than at the present time.

The inhabitants told me that this glacier has never been known to block the Hunza River, but that it is now slowly advancing; and that the snout annually varies to a certain extent laterally. Owing to the instability of this glacier, it was impossible to make any accurate observations or to mark any rocks, as all are moraine material in the neighbourhood of the snout.*

THE PASU GLACIER.

Little Gujhal (Hunza). (Observed 25th May, 1913).—At the top of the terrace on which is situated Baurit, one sees a long lateral moraine placed high on a solid foundation of cliff. This moraine must have been formed when the Pasu Glacier had advanced far into the Hunza River bed. Looking down from this moraine, there were two further lateral moraines visible on this side of the glacier, so it appears that the top one was laid down first, and that the glacier then suddenly retreated. It then appears that the glacier remained stationary while the second moraine was being formed and then retreated again. Another halt and another moraine was formed and this is above the present level of the glacier. It seems too that this glacier has retreated of recent years, for on the map it is shown as right across the Hunza River. But all absence of terminal moraine seems to argue that the glacier has retreated too fast for any bank to form.

Observations on 23rd August.—On August 23rd some further observations were made of the present position of the snout. Owing to the moraines on the south side it was considered inadvisable to put any marks on that side, but the limestone cliff on the northern

* This glacier varies so much that on our return visit late in August, many of the large blocks seen in May, had been carried down by the torrent which now rushed from a much larger ice-cave quite 50 ft. in. height.

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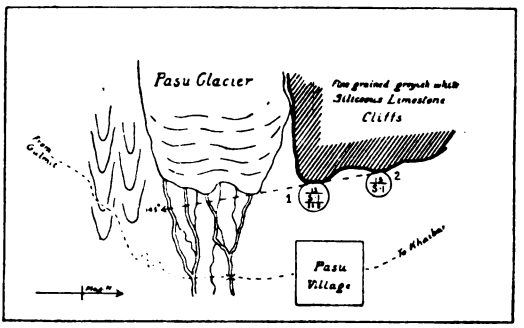
side offered a good place for marks. The sketch below is only rough and not drawn to scale, as there was no time to make an accurate survey. Two marks were painted in black on the cliff as sited roughly in the sketch, so that the line joining them and produced passes



Diagrammatic Plan of the Snout of the Pasu Glacier
23rd August 1918.
Not drawn to scale

through the foremost and northernmost of the two noses, the whole snout being cleft, as shown in the sketch. The lower one $\frac{13}{\text{S.I.}}$ is $\frac{}{23.8}$ near the angle of the cliff, while the higher one, $\frac{13}{\text{S.I.}}$, above a talus fan, is some 100 yards further north on the cliff. The bearing of the indicating line was 145°.

The lumbadar knows the marks and their purpose, and scouted the idea of the glacier ever advancing again sufficiently to do any harm, but gave us the following interesting information about the Batūra Glacier, some 2 or 3 miles north of Pasu.

Note on the Batūra Glacier.—About 40 years ago, the Batūra Glacier advanced and blocked the Hunza Valley, thereby causing a lake to form north of it. This finally burst its glacial dam, caused a flood and carried away part of the old village of Pasu. Near the edge of the river bed are still the remains of houses, and the whole of the bed corroborates this statement.* Opposite the snout of the Batūra Glacier are the remains on the left bank of the Hunza River of a continuation of the Batūra Moraine; but these we were only able to view through field-glasses from a distance. After the deluge the village of Pasu was placed further back.

* It is, however, possible that this appearance of glacial floods is caused by the damming of a glacier in the Shimshal or Shingshal River, which joins the Hunza River between the Batūra snout and Pasu. This periodically happens, the last case recorded being in July, 1906.—Vide *Frontier and Overseas Expeditions from India*, Vol. I., p. 10.

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THE CHAPEL OF MILTON CHANTRY, GRAVESEND.

By MAJOR A. A. CROOKSHANK, R.E.

No doubt it is true of Gravesend as of other places that visitors often see and know more of a town than the inhabitants themselves do. Nevertheless some notes on the old Chapel of Milton Chantry may be of general interest, especially to those who are fond of the history, old buildings, and ancient architecture of this town.

The history of the Chantry and Chapel is well known and need only be briefly referred to. The old Chapel itself is however very little known, partly because it is on the forbidden ground of New Tavern Fort, but chiefly because it is completely cased in in thick brickwork. It is so well disguised that no passer-by would ever take the building on the right of the main entrance gate for a 600-year-old chapel, or suspect for a moment that the plain brick walls which meet his gaze conceal a 14th-century chapel and a quantity of beautiful carved stone work, and of fine chalk and flint masonry, some of it in perfect preservation. History, or rather historians (not by any means always identical) state that Milton Chantry originally covered a considerable extent of ground near the present New Tavern Fort.

The Chapel and Chantry were founded and endowed in about the year 1321—1322 by Aylmer de Vallence, Earl of Pembroke—a license having been granted by Edward II. in 1311 to Roger Orger of Milton. The Earl of Pembroke appointed one Master, one Priest and two Chaplains, and "granted that the priests should have an Altar in the Chapel of the Chantry, and a competent Burial Place for themselves." The Bishop also ordained that there should be "burial places for the ecclesiastics of the institution and for no others whatsoever."

The Chantry was well endowed and owned considerable lands and houses in Essex. It appears that it had a succession of Masters, though possibly not a continuous succession, from the date of its foundation till 200 years later, the last Master, John Dygon, dying in 1524. However, the Chantry is described one year previously, *i.e.* in 1523 (or nearly 400 years ago), as having been "brought to a state of ruin in appearance almost irreparable." It had then been destitute of priests for some time. It is perhaps unnecessary to add that about the year 1534 the Chantry was suppressed at the Reformation.

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In 1540 we read of the "Chapel called Milton Chapel together with the hall, pantry, kitchen, storehouse, chambers, etc., with their appurtenances, and the wharf, orchards, pond, two gardens and two closes of land." The Chapel seems therefore to have rapidly recovered from the state of "irreparable ruin" described as existing in 1523 or 17 years earlier. Another gap, of 250 years this time, now occurs in the history of the Chantry, except that in 1697 "a tenement included in the premises (of the Chantry) was converted into a public-house or tavern" (New Tavern).

The next record is dated 1776 and states "Nothing now remains but the Chapel part, which is built of flints and ragstones, but the window frames and mullions with stone mouldings at the west end. . . . All the other parts of this Chantry are now destroyed." (A similar statement is recorded for 1778). "The upper part of the Chapel is converted into lodging rooms. There is still remaining the receptacle for holy water, but the large Gothic window at the East end of the Chapel is now concealed by a brick building erected against it."

In 1778 New Tavern Fort was built, and in 1779 we read that "alterations were made." In 1779—1780 the premises were purchased by the Crown. By 1788 "the Chapel had been added to a large Inn, built by Mr. James Leigh Joynes and called 'The New Tavern'" (the name used in 1697 being continued). This change from chapel to inn, or tabernacle to tavern, or God's house to public house, was celebrated at the time in a poem of which two lines ran—

> "Where there was grace without meat,
> Now there is meat without grace."

The next record is that in August, 1842, when arrangements were being made for the reception of troops arriving from abroad "some partitions were removed, and the interior of the ancient Chapel was laid open." The history thus shows that the Chapel was in ruins in 1523 and was repaired in the Tudor period, as it was flourishing in 1540. In 1776 it was again in ruins, and was repaired and cased in with brick in 1780. It is a pity that the gap of 236 years from 1540 to 1776 cannot be filled up, also that it is not known what the building was like before it fell into ruins in 1540, and again in 1776, or in other words what the building was like firstly when originally built in 1322, secondly when repaired just previous to 1540 (say 1534—1540) and thirdly when rebuilt in 1780.

On first thoughts one might be inclined to find fault with the builders of New Tavern Fort in 1778—1780 as vandals or iconoclasts for concealing and covering up the remains of the old Chapel with brickwork and plaster; instead of this every lover of the antique ought to be deeply grateful to them for having preserved for future generations the beautiful carved stonework and the fine flint and

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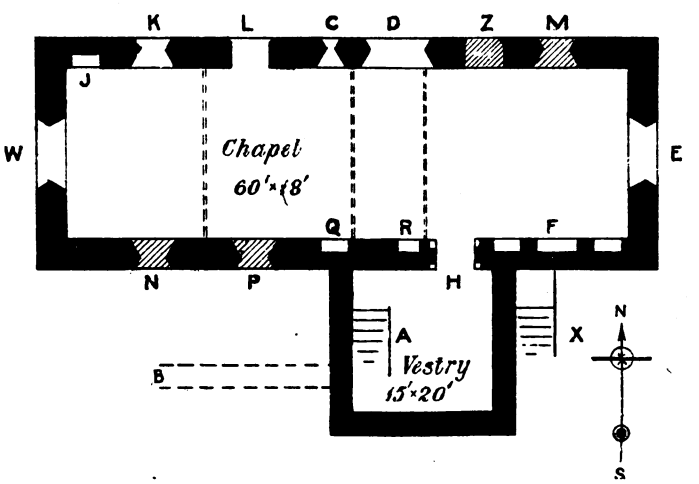
chalk walls which can be admired to-day, although these builders no doubt intended the old work to be buried and not seen again. Most architects in those days, when there were very few archæologists about, would have razed the old walls to the ground and built up an entirely new structure of a different ground plan and having little or no connection with the old.

The Chapel, like most old buildings, underwent alterations from time to time in the course of its long life; it consequently has examples of various periods of architecture, firstly of the early thirteen hundreds (Early English and Early Decorated), secondly the fifteen hundreds, thirdly the sixteen hundreds (Tudor and Perpendicular), fourthly Jacobean and fifthly late seventeen hundreds (Georgian).

It is hoped that a description or drawings of the Chapel may be found among the records of one of the dioceses; as, until these have been examined and carefully compared with accurate plans of the existing walls it is only possible to guess at the arrangement of the building at various periods.

1. The Early English and Early Decorated Period.

The original Chapel, of 1322, consisted of a rectangular building measuring inside about 60 by 18 ft. From the centre of the south side projected a small vestry (see rough *Sketch* I.). There may have been other rooms as well such as quarters for the "Master, one Priest and two Chaplains," a refectory and a cellar, as there are steps at (A) leading to an underground passage or chamber at (B), but the latter may be of some later period; it probably existed in 1540, when we read of the "hall, pantry, kitchen, storehouse, chambers, etc., with their appurtenances."



Sketch I.

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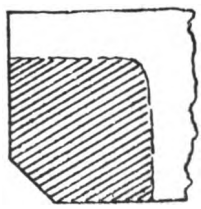
The Chapel had an entrance door, with a large window above it, in the west gable end, and a large window in the east gable end and both these windows have equilateral pointed stone arches, the east window, and probably the west also having mullions in the Early Decorated style and stained glass. In the east window the outer archway with quoins and sill is complete, the inner nearly so; in the west window the inner is complete.

In the north wall there is a narrow lancet window at (C) (of which both outer and inner quoins and the outer sill are complete), and a larger and very high window at (D) (of which both outer quoins and parts of the inner quoin on the east side remain). Both of these are in the Early English style and have stained glass; there is also a door at (L) with a flattened (*i.e.* not equilateral) Early English arch. The quoin on the west side, and the west half of the archway still remain, the latter being in good preservation (see *Sketch II.*, showing



SKETCH II.

section of arch stone). This second door is rather unusual in so small a chapel; but it may have been used as a private entry by the people who lived within the Chantry enclosure and Chantry grounds, while the west entrance, presumably on the public road, was for the use of the public. The second door (in the north wall) may not have been in the 1322 design, *i.e.* it may have been added later. "The receptacle for holy water" mentioned as still existing in 1776 was probably at (J) where there is now a semicircular modern recess made in brick.

In the south wall there are three recesses at the east end. The centre and largest one is about 8 ft. wide and probably contained the tombstone and recumbent statue of the founder, the Earl of Pembroke. It is to be remembered that the Bishop ordained that there was to be "an altar in the Chapel" (possibly at (D) and "a competent burial place for the ecclesiastics of the Institution." The other two recesses, the east one of which is 2 ft., the west one 5 ft. wide, which are much smaller, may have held busts or brass or marble tablets of Masters, Priests or Chaplains of the Chantry or statuettes of saints. The Chapel was dedicated to the Virgin Mary and to the Apostles St. Peter and St. Paul. Two of these recesses have remains of their stone quoins—in the centre on both of the sides and portions of the corbelled sill remain—and in the west

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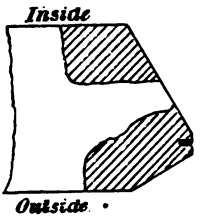
recess both the sides. There is also a fourth recess at (R), about 2 ft. wide.

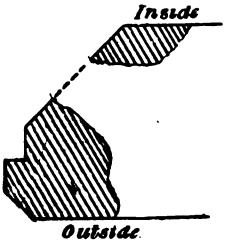
Just west of the group of three recesses in the south wall is the priests' door leading into the Chapel from the vestry. The inner arch (pointed equilateral) and both outer and inner quoins are complete.

There may also have been in the north wall, windows at (K) and (M), and a door at (Z); in the south wall windows at (N) and (P), and a recess at (Q), but these are all doubtful.

The stone quoins are made of Kentish ragstone, which is still, 600 years later, extensively quarried in the Medway Valley below Maidstone. In all the above-mentioned openings the stone quoins are similar, viz., in the Early English style (see *Sketch* III., which shows the dressed stonework in the east and west windows and in the large window at (D) in the north wall). The quoins in the lancet window at (C) are as in *Sketch* IV. The recesses in the south wall

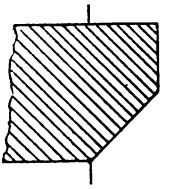


SKETCH III.



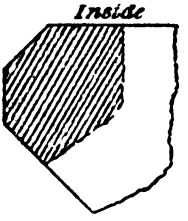
SKETCH IV.

at (F) have, of course, only the moulding (A) which the door (L) also has; of this the west side of the door on the inner side remains. The corbelled stone sill of the large centre recess, previously mentioned, is as in *Sketch* V.

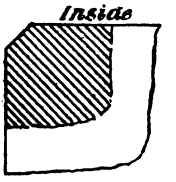


SKETCH V.

The stones in the arch rings of the east and west windows are as in *Sketch* VI., and of the door (L) in the north wall as in *Sketch* VII.



SKETCH VI.



SKETCH VII.

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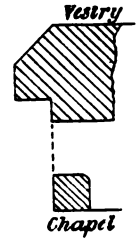
The stonework in the priest's entry is as in *Sketch* VIII. The iron brackets for the door hinges still remain.



SKETCH VIII.

The walls of the Chapel were made of coursed chalk masonry faced on the outside with flint.

This flint work can be seen in its original condition in the east wall, the whole of which is intact and in a perfect state of preservation owing to a building having been added to the east end of the Chapel. There is also flint work in places in the north and west walls behind the brick facing. Of the chalk work there are beautiful examples in the arches of the east and west windows. Nearly the whole of the east wall (inside, all except a small portion of the face work on the north side which has apparently been intentionally cut away) is intact, in its original condition and in a perfect state of preservation, the upper portion being especially fine work. The chalkwork can also be seen in the lower half of the north, south and west walls —elsewhere the original materials have been used promiscuously to rebuild the walls.

As regards the carved stonework the gem of the collection is undoubtedly the priest's entry door—it is a real work of art, beautifully proportioned and in perfect preservation; the same may be said for the inner arch rings of the east and west windows, especially the former, a beautiful equilateral Early English arch. All this stonework is so perfect that it looks quite new just as if it had only left the mason's hands yesterday. Unfortunately the outer arch rings of both east and west windows have gone.

There is also carved stonework, though no with quite such perfect faces and arrises as the above, in the door at (L), the narrow lancet window at C, the high window at (D) and the recesses at (F). The centre one (8 ft. wide) has both sides and sill, the west one of the three has sides only.

The north and south walls are as in *Sketches* IX. and X., that is, as far as it is possible to reconstruct them from the evidence of existing masonry; there probably were more recesses or windows in the south wall at (N) and (P) west of recess (Q) and in the north wall at

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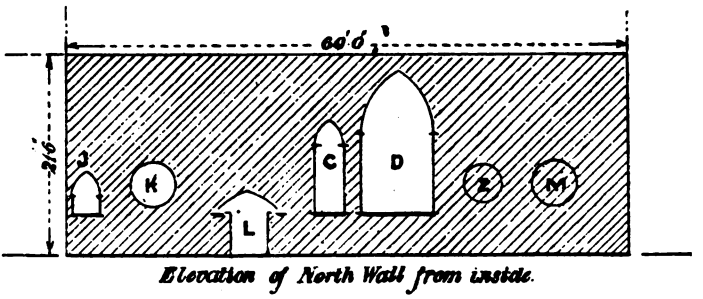
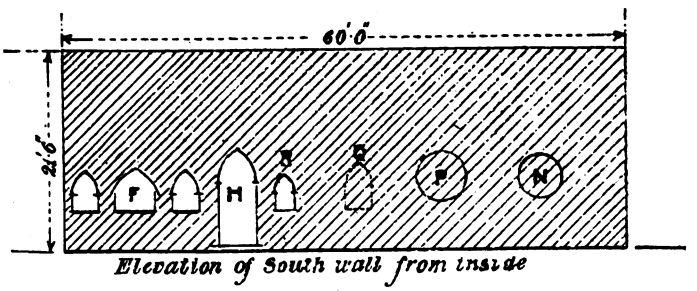


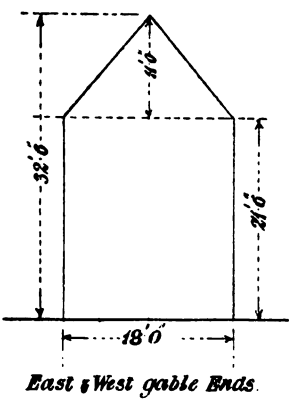
SKETCH IX.

(Z) and (M) east of (D), and at (K) between recess (J) and door (L). It is certainly remarkable that the two windows (C) and (D) should be so close together, (D) being an unusually large one. The absence of

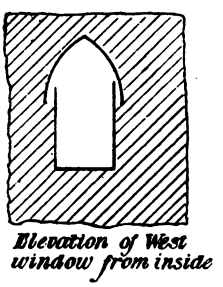


SKETCH X.

lights in the south wall would make the building rather dark, but in those days light was not wanted and chapels were intentionally made dark, the large east and west windows being considered sufficient. As regards the gable ends (see *Sketch* XI.), the east gable had one large three-light window, and the west gable the main entrance door (for the public) with the large window above it. The inner arch ring in the latter is not continuous with the quoins as in the east wall (see *Sketch* XII., of west gable) no doubt in order to make the



SKETCH XI.



SKETCH XII.

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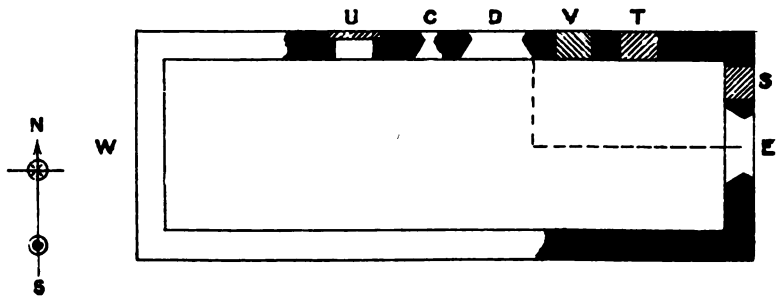
width of the window match that of the door, whereas the east window, facing the congregation, would be made the great decorative feature of the building and would have the widest opening, the finest carving, tracery and stained glass.

All four walls of the building are 3 ft. 3 in. thick.

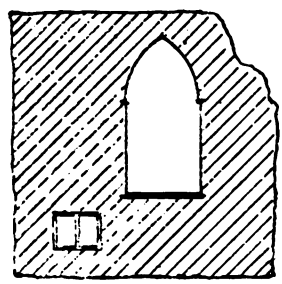
II. THE PERPENDICULAR PERIOD.

After 1534, when the Chantry was suppressed at the Reformation, the building was presumably used for secular and domestic purposes, and apparently a dividing wall was added and each half broken up into two or more stories. The first addition, probably made in about 1540, was a small rectangular window at (S) (see *Sketch* XIII.); it had



SKETCH XIII.

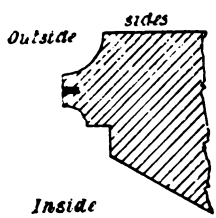
two lights and stained or leaded glass. It is very curiously placed with reference to the east window (see *Sketch* XIV.). The mouldings



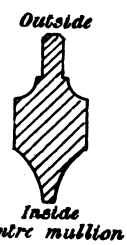
Elevation of East gable wall from inside

SKETCH XIV.

(see *Sketch* XV.) are complete and in fair preservation; the design of the central mullion being rather unusual (see *Sketch* XVI.).



SKETCH XV.



SKETCH XVI.

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The next additions probably made about 1640 consisted of (1) another rectangular two-light window at (T). The moulding (see *Sketch* XVII.) is quite different to that in the window at (S). Only the west side and portions of the lintel and sill remain; the centre mullion and east side are gone. This moulding is in its original condition and in a perfect state of preservation owing to its having been sandwiched between two brick walls, *i.e.*, protected by a thick brick wall on either side.

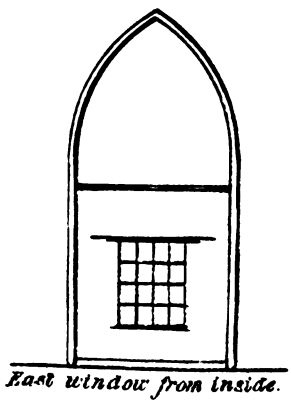
This window and the earlier one at (S) would not have been required unless a floor had been put in above and the east window blocked up. Perhaps the N.E. corner was partitioned off into a separate little room (see *Sketch* XIII.) with a door at (V).

(2). A door at (U). This door probably had a flat Tudor arch (see arch stone in the Museum). The inside arch, as already explained, was a flattened Early English one. Of this 1640 period doorway the west side only remains, but the moulding (see *Sketch* XVIII.) is in perfect preservation owing to its having been protected by a brick wall outside it.

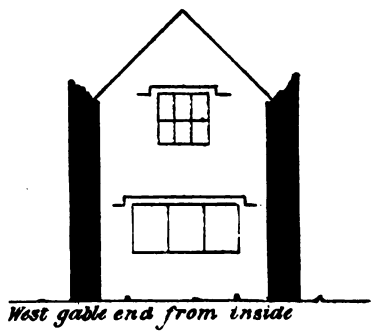
SKETCH XVII.

SKETCH XVIII.

As regards the other domestic Tudor work the gable ends in 1776 were as in *Sketches* XIX. and XX. (see Pocock's *Gravesend*).



SKETCH XIX.



SKETCH XX.

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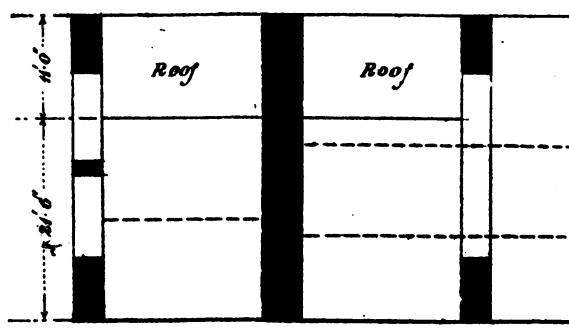
III. The Jacobean Period.

The only remains in the Jacobean style are a staircase, handrail and four newels all of carved oak at (X) (see *Sketch*, page 201), and some carved oak roof trusses in the roof above the priest's door at H, *i.e.* in the roof of the vestry.

IV. The Georgian Period.

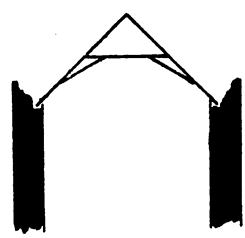
In the 1780 period, when New Tavern Fort was built, the north, south and west walls were faced with 13½ in. of brickwork, the east wall having already had a building added to it. The old walls, where deficient, were made up to the original thickness of 3 ft. 3 in. with the old materials, the chalk and flint being mixed in patches. In some places (*e.g.* upper part of north wall) the flint was put on the inside. When the old materials were used up the walls were completed with brick. This patchwork is especially noticeable in the west gable end (inside) and in the upper parts of the north and south walls.

The building was made into two portions by building across it a thick brick wall carrying chimney flues in it; the east half, with the building to the east of it, was made into three stories, or rather two floors and one roof attic; the west half into two stories, access being by the stairs at (X) (see *Sketch*, page 201) and the whole was roofed over (see *Sketch* XXI.). This roofing (which remained for many



Sketch XXI.

years concealed behind a lathe and plaster ceiling) with its heavy roof trusses (see *Sketch* XXII.) of oak and chestnut, placed close together,



Sketch XXII.

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is a very handsome and striking feature of the building. The roof is covered on the outside with small terracotta-coloured tiles. In the ground floor there is an interesting collection of carved stonework. These are the odd pieces which were found lying about or which were used in 1780 as filling only, the most beautiful being fragments of the decorated mullions out of the east and west windows, and the most interesting being a very large stone, half of a heavy Tudor arch ring, possibly out of the door at L.

These few rough notes on this interesting and, in parts, beautiful old building will have served their purpose if they result in local interest being awakened, in further research being undertaken into the history and architecture of the Chapel and in new discoveries being made.

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NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

No. 8.—*August,* 1916.

THE BATTLE OF THE MARNE.

The writer of the *Revue* article recalls the anxiety caused in September, 1914, to the friends of France when they learnt that a German army had crossed the Franco-Belgian frontier and was marching triumphantly southward towards the Marne. Naturally, the friends of Germany looked forward, at the same time, with glee to the prospect of the triumphal entry into Paris of their Kaiser, an entry which they expected would certainly take place within a few days.

Suddenly a great change came over the scene. From the 6th to the 9th September there was desperate fighting along the line of the Marne, from Meaux to the vicinity of Verdun. During the next six days the German Army fell back on to the line of the Aisne. Since then the hostile armies have ranged themselves, from the Swiss frontier to the North Sea, in entrenched positions facing one another and have remained almost stationary. Both sides were reluctant to give away information concerning the situation in their first communiqués. The Germans only admitted a partial check. The French contented themselves with the announcement of figures relating to the prisoners captured and booty taken.

The German Staff emboldened by the modest nature of the claims put forward by their opponents endeavoured to persuade neutrals and their own people that the Battle of the Marne was only a feint. By degrees the French Press and the public came to regard this battle as a great Allied victory and to speak of it as such.

In the absence of reliable documentary evidence regarding the events referred to, it has been difficult for neutrals to form an impartial opinion on the matter. However, recently literature dealing with this memorable battle has begun to make its appearance. Attention is called to the following pamphlets which deal with the events on the Marne :—

De Liège à la Marne, by Pierre Dauzet (published by Lavauzelle, Paris, 1915, at 2 fr. 50 c.).

La bataille de la Marne, by Gustave Babin (published by Plon Nouprit & Cie., Paris, 1915, at 2 fr.).

La guerre sur le front occidental, 1914—1915, by Joseph Reniach (published by Charpentier, Paris, 1916, at 3 fr. 50).

Von der Marneschlacht bis zum Fall Antwerpens, by Anton Fendrich (published by Franck, Stuttgart, 1916, at 1 mk.).

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Die Schlachten an der Marne (published by Mittler & Sohn, Berlin, 1916). The author is anonymous; export of the work has been forbidden.

There is so little disagreement, it is said, between the French and German accounts in these publications that it may be assumed that the story told cannot be far removed from the truth.

The *Revue* article is written not with the object of describing the battle, but rather for the purpose of analyzing the results obtained therefrom.

Of the pamphlets referred to above the last mentioned has an official ring about it and is probably intended to represent the views which the authorities in Berlin wish the public to take regarding the causes and effects of the battle.

Berlin appears now to have abandoned the attempt it once made to have people believe that *only German Advanced Guards* proceeded as far south as the Marne, as was artlessly suggested in the first accounts of the fighting in this region. There is now no doubt that the main bodies of the I., II., III. and IV. German Armies and "some of the Army Corps" of the V. German Army took part in this battle and were thrown back on to the Aisne.

The question which has to be answered is whether the Battle of the Marne was a German check or a French victory!

There is now no doubt that the extent of territory regained and the prisoners and booty captured were nothing very remarkable.

Monsieur Dauzet in his account says: "We took some colours, 160 *guns*, some machine guns, shells (?), a million rounds of S.A.A., *some thousands of prisoners*."

It is pointed out that the capture of 160 guns was not after all anything excessive, in view of the fact that each side had many thousands of guns in action. Moreover this figure has never been confirmed officially. Again no precise information has ever been published as to the actual number of prisoners taken; this tends to prove that the numbers cannot have been really large.

In the German accounts an attempt is made to prove that the battle was not lost, but that the German Higher Command, after four days of successful fighting, broke off the engagement to suit its own purpose, and drew back the German Armies in order to occupy defensive positions. The anonymous author of the last mentioned pamphlet gives an outline of the battle and puts forward the following theory (taken from the preface to the work):—

"The great events which took place from the 6th to 12th September, 1914, to the south and west of the Marne, between Verdun and the east of Paris, have been magnified by our adversaries, and some neutrals, into a brilliant success, which is a cause of boasting even to-day and on it they base their hopes of final victory.

"The time has now arrived to let in the daylight on these great operations, so that evidence from German as well as French and British sources may be examined and the fact demonstrated that the German armies, during the first four days of this gigantic struggle, were unquestionably winning at all points of the front. It was alone for strategical reasons

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that they (*i.e.* the German armies) broke off the battle in order to take up new positions, which have remained practically unchanged for a period of 17 months. During this period an enormous wastage of British and French forces has taken place."

The writer of the *Revue* article makes an examination of the claim set out above, basing his remarks on the text of the German account contained in the anonymous pamphlet.

To make the situation clear it is necessary to understand what was the plan of campaign adopted by the German Great General Staff. Fortunately, it is set out in the German pamphlet now in question and is stated in the following terms :—" The German Higher Command had decided to push forward the main part of the German forces to the west as a first step and to confide the defence of the eastern frontier to a small number of Army Corps. It was hoped that the latter, in co-operation with the Austro-Hungarian, would be able to hold up the advance of the Muscovite Colossus for several weeks. This would gain the time necessary for the new formations, and above all the active and reserve Army Corps, which would then be available in the French theatre for transfer for the purposes of an offensive in the eastern theatre also."

" It was not intended, however, to wage an offensive war along the whole western front simultaneously. The Great General Staff had decided to remain on the defensive from the Swiss frontier to Donon, and only to pass to the offensive between Donon and Verdun, should circumstances permit ; the principal task of the German troops on this front was to hold the forces opposed to them. Between Thionville and Aix-la-Chapelle, on the other hand, it was intended that the main body of the German forces in the western theatre should invade France, advancing through Luxemburg and Belgium for the purpose. In carrying out this advance, the German Army was to attempt to extend its right wing further and further westward with the object of gaining the seaboard.

" It was hoped, by a gradual wheel to the right, through Brussels, Valenciennes, Compiegne and Meaux, leaving Paris on the German right, to push back the French Armies successively to the lines of the Meuse, of the Aisne, of the Marne, perhaps even of the Seine, in order eventually to outflank them to the south of Fontainebleau and to envelope completely the whole French battle front."

" In this interval, other troops, principally Reserve and Landwehr Army Corps, were expected to reach the coast between Dunkirk and Calais, in order to prevent the disembarkation of fresh British reinforcements."

" The execution of the above plan would, in all human probability, it was expected, be completed by the end of September, and by this time a large number of Army Corps, having become available, would have been massed against the Russians."

" If the objects aimed at were not attained at once, this was not because the plan was faulty, *still less because the German Armies had been defeated by the French*, but for the reasons which are set out in detail following the description of the Battle of the Marne."

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It is pointed out in the first place that the anonymous author gives no indication of the source from which he has obtained the above information. On the other hand, he writes with such assurance that there is reason to believe that his information has been derived from a reliable source. Consequently, the plan of campaign set out above is probably really the one adopted by the German Great General Staff.

In France, at one time it was believed that von Kluck's Army was marching on Paris and that it unexpectedly and suddenly had to change direction on the 3rd or 4th September, in order to strike the Allies on the Marne east of Paris. It would seem that the *rôle* assigned to von Kluck was from the first that of outflanking the French Army, but it would seem that he paid too little attention to the existence of the fortress of Paris.

Nothing could be more logical than the German plan of first beating the French and then turning on to the Russians. To turn the French left, instead of knocking their heads against the eastern ramparts of France, was also good strategy on the part of the Germans, provided only that the French would allow their left to be turned. Events have proved that there was a serious defect in the German plan, sufficient allowance was not made for the use to which the French would turn their excellent railway system. The German fundamental plan worked excellently in 1814, and again in 1870, but it failed in 1914. The Germans were thwarted by reason of the cleverness with which the French made use of their railways to transport whole Army Corps from their right to their left wing during the critical days of 1914.

The Germans have, of course, also made admirable use of their own railways to move troops from one theatre to another at a great distance away. It is, therefore, remarkable that they should not have given their enemy credit for being able to do likewise.

If it is admitted that the German original plan of campaign failed it would be reasonable to assume that faults were committed in its execution. But our anonymous author will not allow any such thing. This is what he says :—

" What were the reasons which prompted von Moltke (on the evening of 9th September) to draw back the German battle northwards for a distance equivalent to a day's march ? "

" (1). The armies of the German right wing and centre were *very exhausted* by forced marches and continuous fighting. They had lost a large proportion of their strength and of their fighting value.

" (2). By reason of the rapidity of the advance, the *supply services* (food and munitions) *were not working* as well as it was hoped they would do.

" (3). The Germans had reckoned on a more rapid reduction of the fortresses of *Liège, Namur and Maubeuge* than events proved possible.

" The resistance of these places gave the French Commander-in-Chief the time necessary to organize his defensive measures on the Marne. Moreover, several Army Corps, detailed for the siege of the places named, were not able to reach the Marne in time to take part in the battle in full strength.

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"(4). *The energetic sortie of the Antwerp garrison*, which took place simultaneously with the French counter-offensive on the Marne, held up certain German Army Corps, particularly the IX. and part of III. Reserve Army Corps. Had these corps been present on the Marne they would have been sufficient alone definitely to defeat the French Army and to crumple up the whole of the enemy's line of battle, already badly shaken at its centre.

"(5). And this was the essential reason: *It has now been irrefutably ascertained that the Russian Government was already determined on war in the spring of* 1914 *for the mobilization of its army had already begun at that time.* According to those competent to form an opinion on the subject, even some on the side of the Entente, the Russians would not, having regard of their methods of mobilization and the immense distances to be covered, be in a position to take the offensive until mid-September. However, the Russian offensive began in the latter half of August, not only against East Prussia but also against Austro-Hungary. Moreover, the Russians brought into the field a larger number of Army Corps than had been anticipated. It had been presumed that they would be compelled to leave the Siberian Army Corps in observation to meet a possible move on the part of Japan, the 22nd Army Corps in observation to meet a possible move on the part of Sweden, the Army Corps in the Caucasus to deal with Turkey and several others as police to repress internal risings.

"The Germans succeeded, it is true, in driving out the Russians from East Prussia at the end of August. On the other hand, the Austrians attacked by the Russian main forces, were not able, in spite of the real successes gained by them at the beginning to stand up against the big 'push.' This is why it became necessary, at the end of August, before the deployment of the German armies against France could be completed, to transfer troops to the eastern theatre. In a communiqué of the 14th September the French Higher Command had recognized that between the 28th August and 7th September the Germans had already begun to move troops from the western to the eastern theatre. It is a fact that at the end of August a few Army Corps were moved from the Western Front and parts of Germany to the Eastern Front.

"In spite of the great military genius of General Joffre, who had recognized the dangers of the situation and taken suitable measures to cope with them, the Battle of the Marne would have been a decisive victory for the Germans, without any unfortunate incidents, *had not the Russian Government already begun to mobilize the Russian Army in the spring of* 1914.

"Even according to French reports, worthy as they are of the highest credence, the Battle of the Marne cannot be regarded as a German defeat. It is rather the case of a *battle broken off by the Germans for tactical reasons*, owing to circumstances supervening which have nothing whatever to do with the battle itself.

"If a study be made of the events during the four great days of battle, from the 6th to 9th September, it will be observed that the Germans had all the advantages on their side almost in every respect; the

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extreme right (von Kluck) and the centre (von Hausen) caused their adversaries to suffer a serious and uninterrupted check.

"As to material results, it can be proved that the Germans captured a larger number of prisoners and guns than did the French."

The foregoing extract causes the writer of the *Revue* article to exclaim, Oh ! ! !

And the latter continues: "Then, it is neither the French nor the Germans who have won the Battle of the Marne, but those knaves, the Russians, who had been making their preparation for this purpose from the time of the melting of the snows.

"Further, no one lost the battle, except perhaps those good-for-nothing Austrians who allowed the enemy to occupy Lemberg, at a time when the soldiers of William the Great were in the act of crossing the Marne as conquering heroes."

If the German Great General Staff wish to convince neutrals of their good faith they are recommended to try a different line of argument and to choose a catchword which is likely to confuse strategical and tactical issues less clumsily.

It is said that, apart from a few sarcastic references to the British Army, the tone of the anonymous pamphlet is in good enough taste.

The writer of the *Revue* article states that he does not quarrel with the reasons which, it is alleged, were the cause of the Germans discontinuing the battle, but he does not accept the reasons given at the value put upon them.

The question is asked: "If it can be proved that Russia was mobilizing in the spring, is it claimed that the German Intelligence Department was so badly informed that it only realized the true situation whilst the Battle of the Marne was in progress?"

The entry of the Russians into Lemberg, on the 5th September certainly gave cause for anxiety, but it could not possibly be a real ground for the Germans to break off, on the evening of the 9th September, a decisive battle, which they were on the point of winning. On the contrary, the Germans, by completing their victory on the western front, would have been in a better position to face the Russians in accordance with the original plan of campaign.

According to the writer of the *Revue* article the real reason for the German retreat lay in the fact that *the German Army Corps in the fighting line were worn out, they had nothing behind them, neither supplies nor reinforcements.*

It was certainly to their credit that the German Higher Command should have seized the opportunity to break off the fight before meeting with a decisive and irremediable defeat.

The anonymous pamphlet informs us that "the retreat of von Kluck and of von Bulow drew in their train the abandonment of the advantages gained by von Hausen. This was the more regrettable since the generals in command of the French centre, in spite of the reinforcements continually reaching them, could not have held out for a day longer. If the withdrawal of the German right wing had not been ordered, for tactical

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reasons, von Bulow's left wing and von Hausen's army would have pierced the French centre on the 10th September."

It is on this latter point that the French and German accounts are in the strongest disagreement. After having been obliged to give ground on the morning of the 9th September, Foch's army had counter-attacked with success at midday on this date. The French Operation Orders for the 10th had directed the resumption of the offensive at 5 a.m. along the whole front. The Germans are really in no way justified in claiming that they would have defeated the French on the 10th.

The anonymous author makes the following statement :—" Towards the close of the morning of the 9th General von Marwitz (who was in command of the screen placed to the south of the Marne by von Kluck) was obliged to report to his superior that he was unable to hold out against the British Army and the 18th French Corps.

" As the superiority of the enemy's left wing became by degrees more marked, General von Kluck was obliged, with the approval of the Chief of the Great General Staff, to order the German troops to draw off.

" The retrograde movement of the I. German Army naturally led to a modification in the front of the neighbouring armies, namely the II. and III.

" In spite of the favourable state of affairs at the German centre, von Bulow felt compelled on the 10th to order a retreat, for he had received an intimation from von Kluck that morning that the latter found it impossible to beat the troops under Maunoury and French decisively owing to the fact that they outnumbered him in the ratio of two to one."

From the foregoing statement each one of us may draw his own conclusions as to which of the two armies stood the better chance of smashing the other on the 10th, had von Kluck not broken off the engagement when he did.

The writer of the *Revue* article has no hesitation in expressing the opinion that von Kluck would certainly have been crushed on the 10th or 11th between the forces of Maunoury and French, reinforced by the 18th French Corps. At the same time, von Bulow, attacked in front by Foch and on his right flank by Franchet D'Esperey, would have found it extremely difficult to escape disaster.

Had the Germans attempted to continue the fight, it is probable that they would have met with a defeat comparable only to that of the losers at Waterloo, Leipzig and Jena. In all probability they could not, in such an event, have made another stand until they had reached at least the line of the Meuse.

The initial mistake made by the German Great General Staff was, as already stated, a want of appreciation of the real value of the French railway system from a military point of view.

It would also appear that, after the first victories of the War which, relatively speaking, were so easily won by the Germans the elation caused thereby at the German General Headquarters led to all caution being thrown to the four winds. The German Army Corps were let loose in chase of the Anglo-French forces in the same heedless fashion that a pack of hounds would hunt a hare. No attempt appears to have been

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seriously made to co-ordinate the movements of the several components of the German invading army with the object of effecting an envelopment of the French Army on any well-considered plan. The German Great General Staff hoped, it would seem, to surround the French Army entirely and not only to outflank it with the German right wing as stated by the anonymous author in his pamphlet.

The writer of the *Revue* article is of the opinion that von Kluck did all that was humanly possible on the memorable days of the Battle of the Marne and that he did not commit grave tactical mistakes as some have asserted.

The late Colonel-General von Moltke, it was generally recognized, did not possess abilities equal to those of his famous uncle and once the great German military machine was set in motion, he was neither strong enough nor far-seeing enough to direct it into the right path. He is said to have hesitated, to have issued orders and counter-orders and to have deferred unwisely to the suggestions of his Imperial master ; there was not present in his mind any dominating idea such as that disclosed in Joffre's handling of the situation.

The German armies were not echeloned sufficiently in depth, but were distributed along the whole wide front. Although the plan of campaign is said to have been based on the idea of utilizing the right wing as the weapon of manœuvre, yet it was on the left wing that the German forces were accumulated.

On the extreme right, von Kluck's Army was too weak to carry out the task assigned to it ; had he been given two Army Corps in addition to those allotted to him, he would in all probability have won the battle.

Joffre's plan for meeting the German onslaught was so simple and so natural that the Germans should, it is suggested, have been able to guess it and to have adopted counter-measures to meet it. The Germans should not have passed by Paris heedlessly as they did without masking it ; it was not only a great fortress but an exceedingly important railway centre.

German strategy went bankrupt in the conduct of operations. Although the Germans started with a plan of campaign which was well thought out and carefully prepared, yet they failed to place superior forces where they were most required at the decisive moment. The natural consequence was that they lost the battle ; the excellence of the machine in the hands of the Great General Staff alone enabled it to stave off disaster.

Tactically the Battle of the Marne was a French victory, as the French Army remained in possession of the field of battle. Strategically, it was the great victory which seems to preclude the possibility of the final triumph of the Central Powers.

A Christian Conscience and the Army.

The *Revue* article is an address for the prosecution (by Capt. E. Chapuisat) before a Military Tribunal in Switzerland, in a case in which one, J.B., a conscientious objector, was accused of insubordination, in that he refused to report for military service.

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The address discloses the following particulars concerning J.B. :—This man had already been tried by a Military Tribunal in August, 1915, and on the 11th of that month had been sentenced to four months' imprisonment, and loss of civil rights for one year (he was also condemned in costs) for refusing to perform his military duties when his unit was mobilized in June, 1915.

At his first trial the accused entered into a long explanation of the grounds on which he claimed exemption from military service. His views may be summed up in a few words : War is the creator of hatred ; the loss of (political) liberty is by no means the worst of all ills.

On his release J.B. was offered a transfer to a non-combatant branch of the Service, but this he refused. He was called up again for a fresh term of military duty in May, 1916, and he again refused to report himself, and indeed wrote to the military authorities stating that he would not serve. At the preliminary magisterial enquiry which took place on the 31st May, 1916, with regard to this man's second default, he re-stated simply the point of view he held on this question and drew attention to the fact that his first conviction had made it necessary for him to resign his position as a teacher in a Government School. He seems to have borne an exemplary character, and to have given complete satisfaction to the parents of his pupils and to the governors of the school up to the time of his first conviction. He further seems to have been careful not to imbue those who were under his care, or those who frequented his company, with the doctrines which had brought him to grief.

Having recited the past history of the accused, the prosecutor informed the Court that although he was now at liberty to bring his address to an end without any further comments and simply to ask the Court to pronounce its verdict and judgment, as provided by law, still he felt that he would not be doing justice by the accused if he adopted this course. In continuing his address Capt. Chapuisat passes in review the opinions which have been held by eminent men regarding the extent to which a man may, on grounds of conscience, claim to be exempt from complying with duties imposed by a State on its citizens. He states that about ten years ago a periodical, *La Semaine litteraire*, published in Geneva, started an enquiry in connection with conscientious objections to the performance of military duties. He did not propose to repeat the opinions of all who were asked to express their views on the subject, but to call the attention to such of these opinions as appeared to him to be of value in relation to the case before the Court. He proceeded to quote the following opinion of Charles Gide :—" I think that a government has the right to inflict on conscientious objectors (in relation to military service) the penalty of exile, nothing more and nothing less. The State should say to such a one : ' It is necessary to impose compulsory military service on all citizens in order to provide for the continuance of our national existence and the majority of the citizens have decided that this shall be the law. Is it to be understood that you accept neither this view, nor this decision ? Alright ! Cease then to be a member of our society and attach yourself to some other whose views coincide with

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your own.' " Capt. Chapuisat, at the same time, pointed out to the Court that these views were very similar to those held by Plato in his Dissertation on Duty (in the *Crito*) from which he quoted the following striking passages :—

"Since thou hast been born, since thou hast been nourished and brought up, thanks alone to us, wouldst thou dare to contend that thou art not our child, and our servant, the same as were thy progenitors ? And this being the case, dost not thou think that thou hath the same privileges as we ourselves possess, in equal measure, so that it may be permitted to thee to do for us all that we should demand of thee ? That right that thou canst have against a master of causing pain in return for pain, of meeting abuse with abuse, by giving a blow for a blow, dost thou think also to possess against thy native land and her laws ? But, if we should endeavour to rid ourselves of thee, believing our action to be just, thou wouldst wish to prevent us to deprive thee of the safeguard of our laws and of thy native land ! Wouldst thou, who makest a profession of being fair-minded, hold this to be justice ? Does thy wisdom leave thee ignorant that thy native land is worthy of respect and veneration, before the gods and mankind, in a degree higher than that due to a father, a mother, aye than that due to a whole race of progenitors ? In order to honour thy native land, is it not necessary to give in to her and to humour her more even than thou wouldst thy angered father ? Is it not necessary to bring her round to thy way of thinking by persuasion, and failing that to obey her commands and even to bear, without a murmur, every burden which she may put upon thy shoulders ? Should thy native land will that thou shouldst be scourged with whips or that thou shouldst be bound in chains, should she will that thou shouldst go forth to fight her battles and to shed thy blood in her cause, it would be necessary for thee to depart promptly without any questionings, for to act thus is demanded by Duty, and one durst neither disobey, nor back out, nor quit one's post, but in the army, in the courts of justice and everywhere, it is necessary to obey the orders of one's native land, or to use persuasion with her on such occasions as this may be permissible, for if it be impious to offer violence to thy father or to thy mother, still more heinous is it to act forcibly against thy native land. . . . And should there be one amongst ye who, not being able to conform in his conduct to our ways, desires to remove into a colony or to dwell in some other part of the world, he will find there is not one amongst us who will oppose his doing so ; such a one may depart from amongst us with all his worldly belongings and establish himself where it seemeth to him best. However, should anyone, after having given full consideration to the manner of the justice and the methods of the police in our Republic, say to us, that he agrees to do all that we may command, yet disobeys us, we hold, for the three following reasons, that such a one acts unjustly in that he does not obey those who have given him birth, in that he tramples underfoot those who have provided him with food, and in that, after having agreed to obey us, he forswears himself and has not taken the trouble to persuade us."

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Leaving further ancient opinions on the subject aside and turning to modern ones, Capt. Chapuisat quoted the following views of D'Estournelles de Constant on the subject of military service: "If one does not approve of it (*i.e.* the law on the subject) one can and one must in such a case exert oneself to bring about a change, either by use of the franchise, by taking other constitutional steps, by propaganda work, etc., but one *must* not act in defiance of it, for this is the negation of constitutional authority, of the social pact."

Very similar views to the foregoing are contained in the declarations of other eminent men whose opinions were next quoted by Capt. Chapuisat. He continued:—

"But what is to be gained by multiplying the opinions expressed by great Christians, since after all conscience is something individual and free, if not altogether independent, thanks to the influences which it at times reflect?

"What is to be gained by reminding B. (*i.e.* the accused) of the Huguenots, and Coligny, or of picturing to him the massacres in Armenia which nations, called Christian, took no measures to suppress by force?

"What is to be gained by going into the question of Belgium, heroic yet unfortunate, which to-day would be passing rich had she preferred to lay down her arms when summoned so to do, but she took another course as her honour demanded that she should resist?"

Capt. Chapuisat observed that he recognized the imperfections of Swiss legislation and continuing stated that possibly in cases of conscientious objection both the motives and the consequences might vary considerably; nevertheless, J.B., the accused in this case, had offended against the law. After dealing with certain technicalities of the Swiss law regarding military service and the punishments provided for, he asked the Court to find J.B. guilty and (*a*) to sentence him to:—

(i.). One year's detention.
(ii.). Exclusion from the Army, in accordance with the provisions of the Military Penal Code, in the form known as degradation.
(iii.). Deprivation of political rights for two years.
(iv.). Payment of costs.

(*b*). To state that the period of detention to which J.B. may be sentenced might, as an act of grace, be reduced or remitted altogether and to submit a recommendation on the point to the General Commanding.

IMPRESSIONS FROM THE AUSTRO-HUNGARIAN FRONT.

The Austro-Hungarian Army with its dozen nationalities, its different languages, and its various customs is, says the writer of the *Revue* article, specially interesting to a Swiss.

This army, so motley in composition, apparently so wanting in homogeneity, has, however, astonished every one, who has come into close contact with it during the present war, owing to its moral unity and its solidity. The present war is not a race war, as is proved daily by the

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operations in which the Austrian Army has been playing a part. Regiments of the Dual Monarchy recruited in Croatia, Dalmatia, Istria and the Trentino are fighting against the Serbians, the Slavs and the Italians; peoples of their own race.

It is stated that a spirit of benevolent tolerance and mutual understanding prevails amongst the twelve nationalities owing allegiance to the Hapsburg Emperor, a fact which much facilitates the co-operation of the forces in which there are such extreme differences in language and in temperament. All the soldiers of the Dual Monarchy know a few words of German which is the official language of the Army, except in the case of the Hungarian Landwehr (the Honved Army).

The striking characteristic of this army is its suppleness, both physical and intellectual. The infantry advances rapidly overcoming obstacles with ease, the cavalry ride with a good seat, in well ordered ranks, and with boldness. Discipline has not lowered the intelligence of the soldiers to the same dead level, nor has it caused an atrophy to set in to destroy their will power; on the contrary, it bends without breaking, it allows each individual as well as each nationality to retain its own characteristics, its own mentality, its own customs in order to obtain thus a combined effort so much the greater by reason of the latitude shown. The special and best qualities of each race co-operate to secure a common end.

The officers of the Austro-Hungarian Army possess intellectual suppleness, they are broad-minded and can adapt themselves readily to circumstances. They possess the perseverance of their German cousins, the charm of manner of the Slav, Magyar pride and the careless gaiety of the Latin races.

The soldier in the ranks is subject to the same influences as his officer; his mentality is a curious mixture of traits in character and of habits which, elsewhere, might appear irreconcilable. He has an open mind, is easily elated, touched with a tinge of oriental fatalism; he is tenacious and not easily disheartened. His strong views regarding his rights do not allow him to forget that he has responsibilities as well.

Men from the north, from the south and from the east meet in the ranks of the Austro-Hungarian Army; the fusion is sufficiently complete to produce a remarkable type of soldier.

The Austro-Russian Front.—Attention is drawn to the fact that the Austrian fronts differ widely from the Franco-German front in the West. The character of the War being waged on the first-mentioned fronts also differs from that in the Western Theatre.

In Galicia and Poland, the opposing armies are constantly manœuvring, and it is only during the winter months that the fronts occupied by them become stationary. The distances between the opposing trenches in this Eastern Theatre, moreover, is measured in kilometres, instead of in metres as in the Western Theatre.

In Serbia: The War is still conducted on the old lines of field operations, in fairly open country.

On the Isonzo and in the Alps: The operations possess all the characteristics of mountain warfare.

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At the beginning of the campaign in Galicia, in 1914, the war was one of manœuvres similar to the field operations of former times, later the opposing forces came to a standstill in the Carpathians until the resumption, in the spring of 1915, of the offensive by the Austro-Germans which resulted in the expulsion of the Russians from Galicia. Since then trench warfare has been resorted to in Bukovina, on the Sereth and on the Styr.

Trenches.—The types of the trenches in use varies according to the nature of the soil. Generally speaking, the trenches have a sinuous trace and are sunk to a depth of about 6 ft. 6 in. below the natural surface of the ground; timbered bombproofs, covered with 3 ft. 3 in. of earth, are provided at intervals. In the sandy soil of Poland very extensive use has to be made of sandbag revetments, and where timber is abundant it is also largely used. No excavations are made in or under the parapets, but shelters for six to ten men are constructed along the rear of the trenches.

On the Pruth, the frequent inundations, caused by the river overflowing its banks, form natural obstacles.

Obstacles in Front of the Positions.—In front of the fire trenches and furthermost from them, a minefield, 20 to 40 yards in breadth, is usually provided, inside this minefield is constructed a belt of military pits, with a high entanglement of barbed wire (4 ft. 8 in. high) over the same, nearer the fire trenches again a second wire entanglement, on short stakes the tops of which are kept within about 12 in. of the ground, is next provided; hand grenades, fastened to stakes by long cords, are strewn along the low wire entanglement. The small movement necessary to disengage these grenade cords when a man's foot catches in them is said to be sufficient to explode the grenades. The gaps left in the lines of obstacles for the patrols to pass through are provided with movable chevaux-de-frise barriers. In the event of gaps being made in the wire entanglements by hostile artillery fire, these also are immediately closed by chevaux de-frise barriers specially stored in the trenches for this purpose.

Measures for Security.—(*a*). Every company in the trenches pushes out a guard consisting of an officer and 20 men to a distance of 800 to 1,200 paces from the fire trench; this guard is provided with telephonic communication with the company commander and is frequently visited by patrols from the company.

(*b*). Each company has also one or two listening posts, consisting of a N.C.O. and two or four men; these are pushed out 400 to 500 yards in front of the minefield.

A short account is given in the *Revue* of the fight of Novo-Aleksiniec which took place on the 26th and 27th September, 1915, when the Russian line was broken on a front of 3,000 to 4,000 yards.

The Russian Soldier.—The writer of the *Revue* article states that he has visited many camps in which Russian prisoners are interned. From what he has seen of them he considers Russian soldiers to be docile, respectful and well disciplined. They retain a military bearing in captivity, they salute smartly and carry out all orders instantly. It takes a good deal to demoralize them.

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The greatest courtesy is said to exist between Austrian officers and captive Russian officers.

The Russian Artillery did not come up in numbers with the Austrian Artillery.

Przemysl.—The forts defending this town were constructed in 1893—1894, in accordance with plans of Lieutenant-Field-Marshal de Salis Soglio ; they are placed at from 10,000 to 15,000 yards from the centre of the town. The Russians almost completely destroyed all these forts during the siege, and what they had left the Austrians completely destroyed before evacuating the town. A detailed description of the destruction is given in the *Revue* article.

After the occupation of Przemysl the Russians attempted to restore its defences, largely by using timber stockading. This town has experienced three sieges in one year, and it would appear that it is now threatened with its fourth siege during the present war.—(*To be continued*).

Notes and News.

Switzerland.—A special correspondent calls attention to a circular, on aeronautics in the Swiss Army, issued to the Press by the Swiss General Staff in which reference is made to the great strides made in military aviation since the beginning of the War. It is pointed out that great expenditure is required to keep pace with the progress made. Thanks to the voluntary contributions of the Swiss people a large number of machines have been acquired for the Swiss Army, but much more than this, it is said, must be done before the Swiss military wing can be ready for active service. The value of dirigibles is frankly acknowledged, but, according to the Swiss General Staff, " this weapon of war is not within our reach owing to the very considerable expenses which it involves."

It is said that the circular in question has been issued in order to prepare the public for the inclusion of a large vote in the Budget for Military Aviation Services, and perhaps also as a feeler to ascertain whether funds can be raised by public subscription for this purpose.

In view of the statement in the circular " that one of the principal *rôles* of aircraft is that of carrying out reconnaissances," it is thought too that it is intended to utilize aircraft instead of cavalry for the purposes of distant reconnaissance work. It is suggested that, if this be the case, it may not be necessary to keep up quite so large a force of cavalry in Switzerland as at present.

The issue of the circular proves that the Swiss General Staff place a correct value on aviation as a means for exploration and observation, the Swiss people will, it is said, readily appreciate the point too.

The prices charged by military tailors for officers' uniforms, etc., in Switzerland is said to be too high. It is urged that the Government should step in and fix maximum prices for the several articles of uniform, alterations and repairs thereto, etc., in order to protect the unfortunate officers, who to a great extent are in the hands of something in the nature of a Trust.

It is said that sufficient attention is not being given in Switzerland to

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gymnastic instruction in schools. A Federal Ordinance of 1909 expressly provides that three hours' instruction per week shall be given in gymnastics in every Normal School, but hitherto it is only in the Cantons of St. Gallen and of Soleure that this rule is being complied with.

The national fête day—1st August—passed off without any unfortunate incident. At Zurich alone were there any anti-patriotic demonstrations; these were occasioned by young men who were to a great extent strangers.

The deaths are announced of Colonels Hungerbühler and Wartman, Lieut.-Colonels Soutter and Grivel and Lieut. de Weck.

INFORMATION.

It is stated that there were numerous errors in the figures given in relation to the Belgian Army in the articles dealing with the operations in Belgium which appeared in the numbers of the *Revue* for June and July of the current year (*vide R.E. Journal* for September).

It is said that at the beginning of the War the numbers of the Belgian Army were not 120,000 men as stated in the article, but 214,000 men.

This number of the *Revue* concludes with a bibliography. Numbers of the books mentioned deal with the present war.

W. A. J. O'MEARA.

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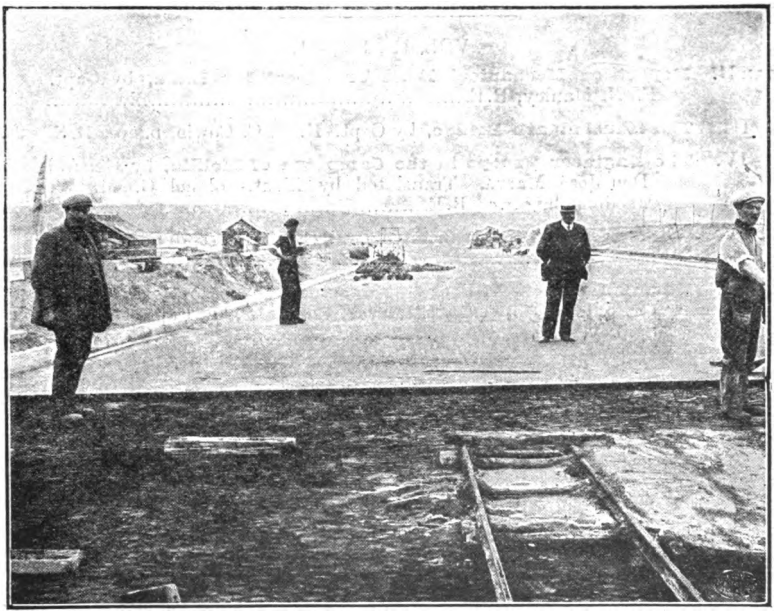

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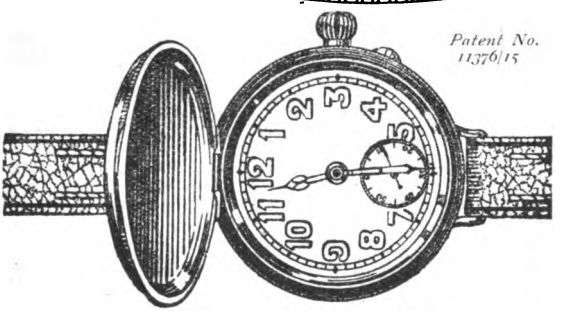

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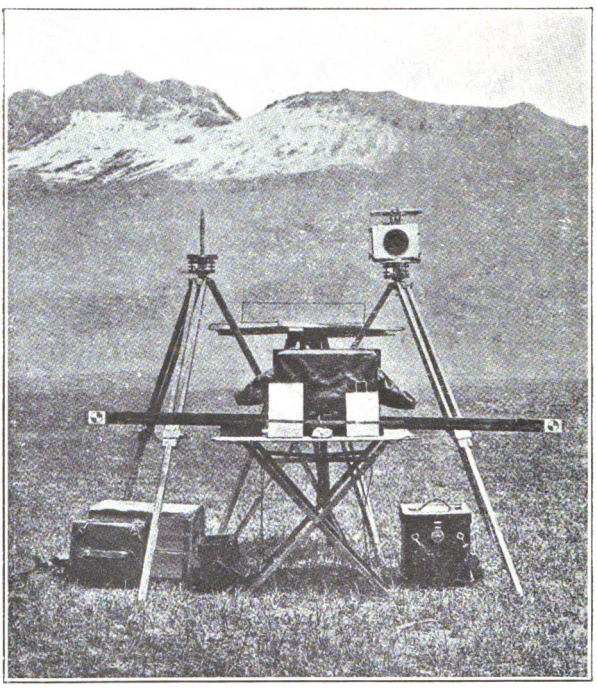
TRIANGULATION WORK IN THE PAMIRS.

Photographic Survey Equipment packed.



Photographic Survey Equipment laid out.

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THE JUNCTION OF THE INDIAN AND RUSSIAN TRIANGULATION WORK IN THE PAMIRS.

[FROM THE RECORDS OF THE SURVEY OF INDIA.]

(*Concluded*).

THE PHOTOGRAPHIC SURVEY.

By LIEUT. (NOW CAPTAIN) K. MASON, R.E.

During the progress of the triangulation, a number of photographs were taken with the object of making a reliable map of the district on our return to India. The great advantage of this method of survey is that, whereas by ordinary methods an accurate map, based on triangulation, is almost impossible to produce during the triangulation, yet by photography, material can be obtained from which a map can afterwards be drawn, based on carefully triangulated points.

The method employed was that known as the Stereo-Photographic; it had not been in use in India previous to 1913, but the method had been tested in Cumberland by its inventor, Capt. F. Vivian Thompson, R.E., and the apparatus had recently arrived in India.

It must be remembered that the topographical survey carried out on the Pamirs had to be considered as of very secondary importance compared with the more important work of the triangulation link; no reconnaissance was possible, owing to lack of time; most of the photographs had to be exposed at or on the way to or from triangulation stations, which were often quite unsuitable; and Hingston, who took many of the photographs had had very little experience of reading topography, and none of surveying.

With any photographic survey a very careful reconnaissance is of the utmost importance. Whereas when surveying with a plane table the surveyor can see exactly how much ground he has covered, the use of photography introduces an element of uncertainty, and leaves a doubt as to whether the whole area has been mapped. In some negatives the same ground will be mainly a repetition of the topography obtained from other negatives, while without any reconnaissance some ground must inevitably be lost altogether.

Photographic survey is only suitable for mountainous country, and can never compete against plane tabling in the plains. It is admirably adapted to the survey of inaccessible parts such as the Pamirs, where it would not be worth while to send a topographical party so far for so short a season. The almost total absence of

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vegetation and paucity of any artificial features render the natural features the only objects to be mapped, so that little is lost in this respect by the employment of photography.

The field equipment is very light, and with all developing materials and sufficient plates to take 60 pairs of photographs, can be arranged into three light coolie loads. For every additional 60 pairs and chemicals for their use, an extra coolie is necessary.

The camera is of the box pattern, similar to that in use in Canada, but adapted for the use of this method. It is arranged with a fixed focal length of approximately 6 in., and has a telescope mounted on the top which is capable of being moved into a position with its axis exactly at right angles to the axis of the camera. The camera is mounted similar to a theodolite, having a base-plate and foot screws, with a silver scale and vernier with which to read horizontal angles, while the telescope is fitted with an arc and vernier for determining the inclination of the stereoscopic base.

The apparatus is supplied with two tripods, which are set up at either end of a base approximately 300 ft. long, arranged roughly at right angles to the direction in which the photograph is to be taken. Having placed the camera at one end with its telescope aligned on an indicator which is mounted on the tripod at the other, a photograph is taken. The camera and the indicator are then interchanged on their tripods, the telescope is reversed in its supports, and after again carefully re-aligning the telescope on the indicator, another plate is exposed. By this means we have a pair of photographs taken on a base, which is measured by a subtense bar, and these two photographs may be placed in a stereoscope. Owing to the fact that the camera axes in both cases have been made parallel, stereoscopic accommodation is possible. By an instrument known as the "Thompson Stereo-Plotter," which consists of a stereoscopic microscope, with an indicator reading to $\frac{1}{100}$ in., a system of levers to transmit automatically the direction of any point observed in the right-hand photograph to a fixed drawing board, and a graduated drum which records the range of the point stereoscopically observed in the two photographs, which is a measure of the parallactic displacement of the two photographed positions of the point, a series of as many points as may be desired may be quickly plotted. This instrument also has another system of levers which give a reading of the heights of all points observed. It is perhaps unnecessary to go into any greater details of the instrumental adjustments and the plotting here, but it may be observed that while the accuracy of each point may suffer slightly in comparison with the Canadian system, yet by this almost automatic method, the far greater number of points that can be plotted without undue waste of time and with a due regard for the economy of the system, leaves the result more accurate and far quicker on the whole finished survey than the laborious plotting of

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points by the older intersection method employed in recent years. The theory of the plotting has been dealt with in a Survey of India departmental paper, and once the observer has become accustomed to the work, he can work rapidly and accurately, a pair of photographs taking on the average from three to four hours.

It should perhaps be mentioned that the plotter has been designed to record photographs which have been taken on an inclined base up to 20 degrees, so that the difficulty of obtaining a suitable base in any required direction is much less than might be at first expected. The adjustment for inclined bases is an extremely simple one. The length of the bases adopted for the survey varied between 50 and 150 yards, the greatest ranges of course being obtained from the longest bases.

As regards the field work, a few points may be mentioned. The plates employed were Kodak Orthochromatic (Green Label), and a high power (×20) orthochromatic screen was used in conjunction with them. Burrough's and Wellcome's Exposure Meter was used to indicate the correct exposure, and was found satisfactory. "Tabloid" Metol-Quinol developer was the developer employed and development was carried on almost nightly in the field in a double tank, in conjunction with a changing bag. This system was found to be highly serviceable. The "Time" method of development was always used, and the negatives were taken out in subdued light and transferred to covered dishes containing a solution of hyposulphite of soda.

Owing to the cold, there were a few practical difficulties which call for mention. The developer was as a rule dissolved and brought to a temperature of about 75° F. But this rapidly fell when, as was usually the case, the development was carried on at night, and a rough mean temperature taken for the calculation of the time. Again, it was found extremely difficult to give the fixed negatives a sufficient amount of washing. Frequent changes were made of the water, but on occasions the water froze before the negatives were changed.

On one occasion, too, drying the washed negative was attended by considerable difficulty, for before the surface water could evaporate, it had frozen to beautiful but unwelcome fern-crystals, and these had to be dissolved off by a very dilute solution of hydrochloric acid. The water was never pure, and during the drying, dust was in nearly every case blown on to the film, and had to be removed later by a gentle sponging with cotton wool and dilute hydrochloric acid.

The negatives after cleaning and drying, were carefully packed in their own boxes, and I may here mention that not one single plate or developed negative was ever broken from the time of packing in Calcutta, till they were safely stored in Dehra Dun after the return of the expedition.

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Though the dark slides were of a good pattern, it was found very difficult to keep out all light from the orthochromatic plates which, as is well known, are extremely sensitive, especially when we had work to do on snow, and one cannot be overcautious in this respect. We found the Gurkhas after a little training, capable of assisting to set up the camera at one end of the base, and of mounting the indicator at the other.

In nearly every case where the photograph was not taken close to a station or triangulated point, the position was resected by a prismatic compass or with the camera itself, by using it as a theodolite. Most of the views were taken to include several intersected points, and in addition the base was always measured with a subtense bar and the camera telescope. The average time taken in setting up, levelling the camera, measuring the base, taking both photographs and repacking the equipment was about 50 minutes. Owing to inexperience with the method, in some cases the intersected points included in the views were too far away to be of any use in the plotting, except for azimuth, and it was then found that the map plotted did not join up with the neighbouring sections as well as when two near well-defined points appeared in the photographs. During the construction of the map it was also found that the chief mistake in the field work had been the failure of absolute levelment of the camera or absolute parallelism of the camera axis in its two positions. In these cases the photographs were adjusted by means of known points in the view, which gave accurate enough results and, though it sometimes happened that the views were projected on planes that were not exactly horizontal, the error from this cause was practically negligible. In one case, during the plotting it was found that the axes of the camera in its right and left positions had not been absolutely parallel; I can only imagine that the camera moved at the last minute before one of the photographs was taken, owing to unequal thawing of the snow under the legs of the stand. This pair of views was almost useless, and was only used to plot a small section, which was adjusted afterwards according to the country adjacent to it. During the field work one pair of photographs was rendered useless owing to the plates becoming fogged, and in another case a pair was temporarily lost through the right and left photographs being taken on the same plate. In both these cases, it was possible to repeat the exposures owing to the fact that development was carried out almost at once and the errors discovered early.

Roughly speaking an average of about 10 square miles was plotted from each pair of photographs. In one favourable case, 24 square miles of complete map were obtained from one pair and this adjusted very well with the neighbouring section.

It was originally hoped that a fairly complete map would be obtained of the Taghdumbash Pamir, but the exigencies of other work; and the breaking up of the weather at the end of the season rendered

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the completion of the work impossible. It was therefore decided to plot as much as possible on the 1-in. scale with contours at 200-ft. vertical interval, and reduce the map to a smaller one, adding as much of the omitted portions by eye from the stereoscopic pairs. These omitted portions generally consisted of the bottoms of valleys, of which the boundary hills could be seen, or of portions of country too distant to be plotted by the method. In the plotting, heights were estimated to the nearest 50 ft., and in all cases where two or more triangulated points appeared in the view, the plotted height agreed with the triangulated height within this amount. The contours of adjacent plotted sections in almost every case agreed easily in height to within 200 ft., there being a few exceptions in very steep ground, where the contours were very close together.

One other difficulty which was very apparent during the subsequent plotting was the great contrast of the high lights on the snowy hills and the dark ground of the valleys, and I found that though we had anticipated this to a certain extent and over-exposed the hills in order to get the utmost value over the whole picture, yet it was almost an impossibility to get sufficient detail in the valleys for plotting, when there were great high lights in the picture.

The photographic survey has added to and corrected portions of the existing map of these regions. The accuracy obtained may be considered as at least equal to any that would have resulted from a ¼-in. plane-table survey, though the 1-in. plotted map is probably inferior to a detailed plane-table survey on this scale, which would however have been far more costly in time and money. This inferior comparison may be referred to the length of some of the ranges employed, which in some cases amounted to over 10 miles. This range however was never employed unless a triangulated point appeared in the distance.

I do not think that the method would prove of any great value in India itself. It seems to me that the plotting must be done by a responsible officer and that the difficulties of adjustment of the pairs of photographs in the stereoscope for slight errors in the field work would not admit of the work being done by a surveyor. Undoubtedly the method is a feasible and accurate one, and in certain cases a very valuable one ; but these cases are the exception and not the rule. A traveller in the Himalaya, who had but little time on his way to make a map, could bring back photographs which would supply definite information on a disputed point, for example, the drainage of certain valleys, or the location of an uncertain pass. An officer who reached the frontier of a neighbouring territory into which he had been forbidden to enter, could increase our knowledge of the transfrontier without violating his orders. Finally, in the case when an accurate map is required on a small scale of a distant country, which is entered for other than topographical objects, when weather or other considerations considerably shorten the period

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available for topographical work, this method of photographic survey will be found economical; because a practically negligible increase of expenditure while in the country in question will ensure a far larger section of mapped country, and though the expense of plotting after the return is practically entirely additional, if one arrays against this the cost of sending another expedition to complete the survey, or the cost of the upkeep of the detachment in the country until the conditions become more favourable, one will find that the comparison is all in favour of the photographic method.

CONCLUSION OF THE OPERATIONS.

Capt. Mason deals with the conclusion of the operations in the 13th chapter of the Records as follows:—

On the 14th August the Pamir detachment commenced its journey back from the Taghdumbash. Collins had finished the triangulation on the south, and assurances came in from McInnes that in a few days the Chapursān work would be completed. Even so it was with a feeling almost akin to regret that we said good-bye to our hospitable friends, the Begs, who came in to Mahomed's khourgas at Mintaka Akhsai to see us off. We distributed presents among them and Mahomed himself gave me his ancient sporting matchlock. Arzu, our invaluable Sarikōli guide and interpreter, had come to me some days before and asked me to take him back to India "to see the world," and after some consideration I had agreed to do so. Hingston, the ardent hæmatologist, insisted on the condition that Arzu should supply samples of his blood on the way down to lower altitudes to complete his investigations into the behaviour of corpuscles with altitude, but by now, most of our friends had become used to his bloodthirsty tendencies, and agreed to be "stuck" without demur. However, when Arzu approached his father, Mahomed, the local Warden of the Marches, the latter refused to allow his son to accompany us further than Gilgit. Some hereditary distrust of the men of Hunza lurked in his bosom, and when we finally left his camp, the old man followed us some way, begging us to ensure his son's safe return.

Our last glimpse of the Pamirs was characteristically equal to the occasion. As we neared the summit of the Mintaka Pass, Hingston and I, who had halted to take a few final observations for the photographic survey, were caught in a violent snow-squall which drove all of us who were near enough, Baltis, Hunzakūts and Gurkhas, into the stone dâk-hut, where we had to wait until the storm subsided. We pitched camp at Gulquaja Uwin and on the 15th arrived at Murkushi, where we halted for a day, owing to the non-arrival of the extra baggage coolies.

Two days afterwards we reached Khodabad, McInnes' base. After leaving Misgar, we found that the bridge by which we had crossed the river on our northward journey had been swept away, and the only path which remained was a goat-track, which ran for

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some distance along the east side of the river, and then crossed by a frail log laid on boulders in the stream. In places it had not been considered worth while to improve the track for mere mortals, as the river would soon subside and make the winter route again practicable. From the flat which we climbed on the right bank, we could see remains of old river terraces extending up to 2,000 ft. on the opposite side; this gives one some idea of the enormous cutting power of the Hunza River, and an interesting insight into the rejuvenation powers of mountain streams. There is a particularly formidable *parri* along this march on the summer route which we had to traverse; this is the one that avoids the long détour *viâ* the Kermin Pass. It is a case of almost hanging on by the eyelashes, and in places the track merely apologizes for its existence. There is for the most part no roadway of any description, not even one large enough to be supported on props or pegs, and this for a country which has a maximum width of about 2 ft. for its best hill roads is saying a good deal. Joints in crumbling shale, worn pockets in slippery granite, these constitute the alignment of this remarkable stretch.

We halted at Khodabad until the 21st, in order to make certain that McInnes would have no difficulty in finishing his work, and to assist in forwarding supplies to him. Here we received maps from Dehra of the Hispar-Biafo route into Baltistan. We had obtained permission to return by this way, but the lateness of the season (we should not be able to start from Hunza till September), and the continual bad weather which was experienced all August, finally caused us to abandon the scheme.

All down the road, people were most hospitable; probably they were glad to see the last of us, for, however much we may have tried to lighten the burden of our existence in this country, it must be admitted that an expedition of such a size must cause a good deal of inconvenience to the inhabitants, however well paid they may be. At Khaibar, where we spent the night of August 21st, the lumbadar practically stripped his trees of apricots for us; and this kind of hospitality existed all the way to Hunza.

There is not much of interest to mention between Kahaibar and Aliabad. The track at times ceases to exist, but the only really sensational portion is a 3-mile stretch just north of Atabad. The path zigzags up a cliff, which it traverses on pegs and props, about a thousand feet above the seething chocolate-coloured torrent. One cannot help feeling a distinct concentration of attention on footholds. Failing this concentration, the glance is apt to stray to the waters below, while the imagination commences to calculate distances and depths, which I believe causes the desire in some people to throw themselves down.

At Gulmit, I found a man who had been to Raskam in the old raiding days, and he was able to corroborate and amplify the information which I had received on two former occasions as to the

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Raskam route into Baltistan. Raskam has never been repopulated since the Hunza raids which ceased over twenty years ago. My informant explained that he did not follow the route which he described, but that the way was pointed out to him by a man who had accomplished the journey. Apparently it was not a summer or autumn route owing to the amount of water that fills the river during these periods. The details he gave me were as follows:—Pasu to Shingshal, 3 marches; from Shingshal onwards down the Raskam Shingshal River, 4 marches; here a *nala* enters the valley from the south which has to be followed to a pass at the head. The man was unable to give me any precise information as to where the route led to on the Baltistan side, but he was quite definite when he asserted that the *nala*, which was pointed out to him, left the Shingshal Valley before the latter reached the Oprang. From this it appears that the route must either enter the Biafo or Punmah Glaciers. Apparently the route was occasionally used by men from the Pamirs *en route* to Baltistan, who travelled *viâ* the Pamir Oprang and the Raskam Shingshal.

The Pamir detachment reached Aliabad on August 25th. Collins had already arrived, and the paying off of permanent men and general settling up of the affairs of the expedition was commenced. McInnes arrived on the 30th, having completed the work in the Chapursān, and we all enjoyed a few days' rest before leaving for Kashmir. On the 2nd, Hingston and I definitely abandoned the idea of returning by Baltistan owing to continued bad weather.

The detachment was again divided into two parts for the journey back, and the leading portion reached Gilgit on September 5th. Here we found that the Resident, the Hon. Mr. Stuart Fraser, had arrived the same morning, while all the British officials were in the station.

From Gilgit we travelled to Kashmir with Major Webb and Capt. Moore, *viâ* the Kamri Pass, which gave us a variation from our previous route. All the way we had perfect weather until we reached Gurais, when a bad spell set in. The Rajdiāngan Pass was crossed in a snow blizzard and Bandapur was reached on the 15th.

While waiting for the arrival of the second detachment, Hingston and I went into Srinagar, where we had the pleasure of meeting Dr. de Filippi and the other members of his expedition which was on its way to winter quarters at Skardo.

The detachment returned to Dehra Dun in October. Every man was in perfect health. During the whole of the time during which the expedition had been away, there had been only one casualty, which happened to a coolie on the road north of Hunza. This man apparently lost his nerve on a *parri* or bridge, became dizzy, fell into the river, was swept away and drowned. With this one exception, there were no accidents and no cases of more than very temporary sickness among any men connected with the expedition.

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MESOPOTAMIA.

By CAPT. F. C. MOLESWORTH, R.E.

DESCRIPTION OF COUNTRY.—The country now (October, 1916) in occupation of the Mesopotamia Expeditionary Force may be said to lie between the mountains of Luristan* and the sandy desert south of the Euphrates. Its length is about 250 miles and its extreme breadth about 120 miles. Nearly the whole of this country consists of silt brought down in past ages by the rivers Euphrates, Tigris and Karun. The delta of these rivers is extending seaward at the rate of about 80 yards a year; hence the farther one goes back in history the greater is the extension of the Persian Gulf north-westwards. Thus, old Basrah was a seaport in early Muhammadan times; when Alexander the Great invaded the country the head of the Gulf was a few miles above where Qurnah now stands; while "Ur of the Chaldees" (see Gen. 11. 31), the ruins of which are south of Nasiriyah, was a seaport about 2000 B.C. It is believed that in very recent geological times the Gulf extended almost to the Mediterranean.

From these considerations, the leading characteristic of the country is obviously its flatness. Baghdad is not more than 100 ft. above mean sea level. Between this place and the sea the only rises of ground met with are artificial. Much of the country is permanent marsh. The Tigris and Euphrates are flooded from February to June (owing to melted snow in the mountains of Armenia) and overflow their banks. Villages, date groves and crops on low-lying ground have then to be protected by clay *sadds*. The rise of the Tigris owing to floods may amount to about 20 ft. at Ali-al-Gharbi, a considerable portion of which may occur in a few hours. At Basrah the rise owing to floods is 6 or 7 ft., sudden rises being infrequent.

The tide is felt up the Tigris about as far as Ezra's tomb, its rise and fall at Basrah being about 3 or 4 ft. at spring tide.

The Tigris is fringed by date groves on both banks from its mouth to a few miles above Qurnah. There are isolated groves higher up the Tigris and also on the Euphrates. The date palm is useless for

* These mountains are commonly called "Pusht-i-Kuh." This, however, is the name of a district of Persia, the word meaning "beyond the mountain." There is apparently no vernacular name for the series of mountain ranges in the district "Pusht-i-Kuh."

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engineering purposes, except for revetments, crib-piers, etc. Other trees are very scarce.

Country other than marsh or cultivation is usually a light soil, sometimes covered with camel-thorn or tamarisk scrub (there is little grass). After rain, or after being flooded, the soil becomes a very tenacious mud, in which it is impossible to ride or bicycle and very difficult to walk. It remains in this condition for several days.

Basrah is a large town situated up the Ashar Creek 2 miles from the Shatt-al-Arab (the name given to the Tigris and Euphrates after their confluence). There are a great many shops in Basrah and Ashar, where most necessities of life are obtainable—hardware, crockery, cutlery, tinned and bottled provisions, whisky, etc. In fact, one seldom now needs to send to India for anything. There are some branches of well-known Bombay firms of outfitters, where ready-made uniforms are obtainable, as well as most articles of camp kit. There is a branch of the A. & N. Stores in Ashar, which, however, keeps a small stock only, but will procure articles from Bombay at Bombay prices plus Customs duty. Local shops include watchmakers, tinsmiths, etc. There are some Indian *dirzis*. There is a club in Basrah, started by the British residents before the British occupation, which all officers belonging to the Force are kindly allowed to use. There is also a free library with a good selection of books, and there is a daily paper, the *Busra Times*. Besides the services taken by chaplains attached to the Force, an undenominational service is held on Sunday evenings in the American Mission Church.

The usual method of progression in Basrah is by *ballam*, a sort of gondola which can be poled or rowed by two men. Tariffs can be seen on a notice board near Whiteley Bridge on the Ashar Creek. There are also victorias for hire, but these are little used except for driving between Ashar and Basrah city.

Magil has grown up almost entirely since the British occupation. It lies 5 miles up river from Basrah. There are as yet few shops, but Basrah can be reached by motor ferry which plies several times a day between the two places. The journey can also be done by *ballam*, which costs Rs.1. 8. 0 each way and takes longer.

Amarah has a better climate than Basrah and is altogether a more agreeable place. There is a *bazar* where provisions can be obtained. A club has been started. Amarah is a compact place and most of the military locations can be reached in a few minutes by walking from the river front.

CLIMATE.—The temperature varies from below freezing in winter to 120° F. or even more in the shade in summer. From November to February the nights are very cold, and frost is not uncommon;

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during this period it is warm in the middle of the day unless cloudy; up river a piercingly cold wind sometimes blows for days on end; as this wind is mixed with dust it is very unpleasant indeed. Rain occurs at intervals, the greater part of the annual rainfall (8 to 10 in. at Basrah) falling during this time; rain occurs most frequently when a S.E. wind (up the river) is blowing.

During March and April the temperature increases and 100° F. in the shade may occur in the latter month. Rain is less frequent, but showers may fall even in May, after which there is no rain until November.

May and June are very hot months. The temperature rises to 115° or even 120° or over, and often does not fall below 100° for days on end. There is very little wind. Where the climate is moist, *e.g.* at Basrah, the weather conditions during these months are very trying indeed.

The severity of the hot weather is mitigated by the *shimāl*, a N.W. wind, which begins about the end of June and blows with varying force for about forty days. During this period, though the temperature still remains very high, the air is in motion and the humidity less, consequently it feels cooler.

After the cessation of the *shimāl* the weather is again very trying, and remains so throughout August and the beginning of September. Then the temperature drops gradually.

October is perhaps the pleasantest month of the year, as the nights, if not the days, are cool and there is no rain.

Bad as the climate is, it is probably not as bad as many parts of India (the Derajat for example), but the conditions inseparable from field service make it more trying. Officers accustomed to the breathless nights in the hot weather in the north of India will find the nights in Mesopotamia much more agreeable, for there is always a drop in temperature and very often a breeze. It is possible to sleep on a roof in comfort without a fan every night, except perhaps three or four, in the summer. It is not necessary to shut up houses, as in India; in fact it is often cooler with all doors and windows open.

A few words may be added regarding the insect pests of Mesopotamia, which are probably unequalled anywhere. Flies are prevalent in spring, and later on during the date harvest (September). Mosquitoes abound during summer and sand flies during autumn. But they are by no means confined to these seasons and are only entirely absent in the very coldest weather. Their absence is compensated for by the activity of fleas, a very large and efficient variety of which inhabits houses formerly occupied by the Turks or their late subjects. There are few white ants in Mesopotamia, and such as there are are not nearly as destructive as the Indian species. Scorpions are plentiful, especially in Amarah.

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INHABITANTS.—Most of the inhabitants are Arabs; the remainder are mostly Chaldeans, who may roughly be described as the non-Musulman inhabitants of the country. The neighbouring Persian province of Arabistān is also largely inhabited by Arabs. There is a considerable number of Jews.

One comes in contact mostly with the lowest type of Arab—small traders, coolies, artificers, etc.—a type which in no country represents the best of a people. The coolie is lazy, but develops astonishing energy when employed on piece-work. The artificer class has more self-respect.

Arabs are Muhammadan in religion (*Shiahs*), but are not fanatical. Coolies often take a day off on Friday.

The non-Musulmans, called Nasrani (*i.e.*, Nazarenes) by the Arabs, are traders, clerks and sometimes blacksmiths. They lack stamina and force of character—defects due to having been systematically sat on by the Musulmans for centuries. Their religions include Chaldean, Armenian (isolated relics of early Eastern Christianity), Roman Catholic and Greek Church. This section of the people received the British with open arms.

The language of the people (Arabs and Nasranis alike) is a dialect of Arabic. It differs from standard Arabic in the pronunciation of some consonants and the addition of many words, chiefly Persian; but the written language is practically the same. I do not think that anyone who had learned Arabic in Aden or Egypt would have much difficulty in picking up the local dialect. The Arab works much better for an officer who knows even a little Arabic, and when addressed in that language makes an effort to help the speaker, and does not use his natural stupidity as a weapon of offence, as the Indian is apt to do when confronted with a learner of Hindustani. The only work on Basrah Arabic is a small pamphlet published by the General Staff in Mesopotamia. The system of transliteration employed in it is difficult for students used to the Hunterian system. "Arabic self-taught" is not of much use as it deals with Syrian Arabic.

There is an exam. in Arabic known as the "Field Service Test" held quarterly at various places in Mesopotamia, for passing which a reward of Rs.300 is given. It is entirely colloquial, consisting of conversation with local people on military or general topics.

Besides Arabic, Persian is sometimes useful, and a knowledge of Hindustani is spreading among the classes mostly in contact with members of the Force. Occasionally one comes across a petty contractor who speaks French only among European languages, but a knowledge of English is spreading among these people.

The better-class houses are two-storeyed, built round a central courtyard, with one big door opening into the lower storey. Officers living in Basrah, Amarah, etc., live in such houses. A large number

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of reed huts, or composite huts with corrugated iron roofs and reed sides, etc., have been made for officers and men.

In certain parts of the country officers have suffered a great deal from thieves—in some cases the entire contents of a tent have been removed while the occupant slept.

KIT.—As far as I am aware, no restrictions are made as to the amount of kit one is allowed to carry by transport from India. The amount one is allowed on river steamers may be restricted, but in any case if one were moving up-river, one would leave a certain amount at the base. One can hardly have too many shirts, etc., as in the hot weather, owing to dust and perspiration, they become dirty very quickly, and opportunities for washing them may be few and far between.

In the following paragraphs no attempt is made to include everything that an officer will need on field service, but only necessary additions and modifications to one's Indian kit owing to conditions in Mesopotamia.

Head-Dress.—The ordinary khaki helmet is too thin for the hot weather and a Cawnpore topi is essential. An extension to cover the back of the neck is also needed. These can be obtained from the S. & T.

Shirts.—In the hot weather, nearly everybody discards coats and wears shirts only—no ties. Patterns with pockets and removable shoulder-straps are most useful. If a shirt is worn without coat or vest, a spine-protector (obtainable from S. & T.) *must* be worn.

Coats.—Ordinary drill are perhaps the most serviceable. Home pattern khaki is very much used in winter. *Pagri*-cloth coats are useful in the hot weather. A coat British warm is necessary, as also is a light waterproof.

Leg-Wear.—In summer shorts have to be discarded owing to the many insect pests with which the country abounds. Riding breeches make one uncomfortably hot. Trousers should have loops for a belt. Thick drawers and socks, etc., are necessary in winter.

Boots.—The wear on boots is agreeably small owing to the absence of stones in the soil. An old pair of Wellingtons is useful after dark in the hot weather to prevent mosquitoes from biting through one's socks. A pair of deck shoes is useful.

Swords are practically never worn. Warm gloves are useful, but not essential. Goggles are almost indispensable.

Bed.—Bring two mosquito nets, and a bed fitted with poles for nets. The mesh should be very fine, in order to keep out sandflies.

Bedding.—A useful kind of quilt, known as a *tihāf*, can be bought for four or five rupees in Basrah. This can be sewn into a fleabag in winter. Besides this, at least four blankets will be wanted in the depth of winter.

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Although you will probably live in a Mess (there are R.E. Messes at Basrah, Magil, Amarah and with most of the larger units up the river) you will need crockery and cutlery, etc., of your own and cooking vessels. A *sigri* is useful on river steamers. As water for washing up is sure to be dirty bring a supply of permanganate of potash for the purpose, and see that your servant uses it. It is useful too for baths and for water for cleaning teeth, etc. A little goes a long way—a pound will last for a month or two.

Bring a very large supply of insect powder. Most preparations for keeping off mosquitoes, flies, etc., if used at all, have to be used in such large quantities as to be very unpleasant.

An electric torch is very useful. As batteries deteriorate very rapidly, you should arrange for a supply of fresh batteries periodically. Batteries for some torches can be obtained in Basrah.

A tent is of course necessary, although if you are stationed on L. of C., you will find accommodation in a house or reed-hut.

A bicycle is useful in most places. It would be quite worth while bringing a motor bicycle or even a light car, but if your job entails much travelling about, it would generally be possible to get a Government car.

Small weighted pieces of muslin for covering drinks, etc., are very useful.

SERVANTS.—It is necessary to bring with you from India a bearer and a sais. They should be very carefully examined medically before being sent to Mesopotamia; too much stress cannot be laid on this point. They will probably ask for a large advance before leaving, and it is advisable to send the bulk of this yourself by money order to their relatives. As the best class of Indian servants is disinclined as a rule for service abroad, and you will probably have to engage new ones, it is best to possess yourself of their chits and to deposit them with your agents.

As regards pay, I believe the rates of Rs.30 a month for bearers and Rs.25 a month for saises have been officially sanctioned. They get free rations in addition, and will probably ask for free clothing. This is usually given and should include duplicates of everything washable and a warm coat, also blankets. Each should be provided with a mosquito net. Needless to say, the bearer should be able to cook for you.

The local Arab does not make a good servant as a rule—he is quite unused to sahib's ways and is very casual. Arab servants are undesirable for political reasons in certain districts. Indian servants may be picked up in Basrah, but they are naturally not the best.

Servants should be provided with identity discs which they must wear always. A servant unprovided with a pass is not allowed access to the *bazar*. Don't forget a tent for your servants. Most servants

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on reaching Mesopotamia make an attempt to wear the ends of their *pagris* loose. Needless to say this habit should be jumped on.

Some sweepers are obtainable locally in addition to those in S. & M. units, etc.

There are a few Indian *dhobis* in private practice. As this practice is extensive you cannot count on getting your clothes back within a fortnight, and so have to calculate your quantity of clothes accordingly.

HORSES.—These can sometimes be obtained from the Remounts, but it would be advisable, if time permits, to enquire before you leave India. In any case a sais is necessary. Rations for the authorized number of chargers are drawn free.

If you take chargers from India, have them registered (*i.e.*, their age, description, value, vet.'s certificate, etc., taken) and send the register to H.Q. of your unit or divisional C.R.E. in India. This is useful in case you lose your charger.

The Remount Depôt in Mesopotamia purchases chargers of officers killed or invalided.

A warm blanket is needed in winter, and a network *jhul* for the fly season. Shoeing can be done by any mounted unit in the neighbourhood.

PROCEDURE ON ARRIVAL.—The voyage from Bombay to Basrah occupies five days; that from Karachi to Basrah four days. During the monsoon the first two or three days will almost certainly be rough. The latter part of the voyage is extremely hot in summer. Chargers should be provided with 7 to 10 days' rations before leaving India (in the case of a transport these are obtainable on board). Messing for yourself is arranged for on board and is free.

If your steamer is of deep draught it may be necessary to transship to a smaller vessel at the Bar outside the mouth of the Shatt-al-Arab.

Steamers proceed to Basrah or Magil. At the former place they anchor in mid-stream; at the latter they sometimes go alongside piers. In either case they are boarded by a member of the Embarkation Staff, who tells officers where to go to get orders. Both places are full of signposts and maps on boards showing the principal offices.

If joining an appointment or unit up-river you will probably have to spend some days in Basrah or Magil before accommodation in a river steamer is available. There are rest camps at these places.

A journey from Basrah to the front by river steamer may occupy 8 or 10 days when the river is low, so rations must be taken accordingly (there is usually time to go ashore at Amarah and draw fresh

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rations if necessary). Officers have to make their own arrangements for cooking and messing on board these steamers. In the more difficult reaches of the river, the steamer often bumps the bank, which gives opportunity to your servant to buy fowls and eggs from the villagers, who gather round to sell them. Clean water is always obtainable on board and sometimes ice. A few of the steamers have cabins, but on most you have to make shift on deck. In the worst parts of the river steamers tie up to the bank at night; opportunity is thus given for exercise ashore.

At the front steamers are met by military landing officers, who direct officers where to go.

PAY, ETC.—Family allotments can be made to India or to England or to both. The O. i c Clearing House, The Strand, Basrah, will give all information about allotments.

Indian currency notes, silver, nickel and copper are current and are accepted everywhere. English notes and silver could probably be exchanged at a F.T.C.O.'s. Small Persian coins up to a *kran* (4d.) are met with and Arabs frequently use these in computation. A few Turkish nickel coins of small value are sometimes found. In calculations with petty contractors the *lira* or Turkish pound (Rs. 13. 8. 0) is often used.

Rs.200 a month for personal use (Mess bill, servants' wages, etc.) will about see you through.

HEALTH.—Too much consideration cannot be given to details conducing to good health. Various recommendations are published from time to time by the medical authorities *re* preventive measures against diseases. It is as well to be inoculated, before leaving India if possible, against enteric and cholera.

Food.—It is as well to supplement one's rations by fresh vegetables whenever possible. Lettuces, a kind of coarse turnip, beans, cucumbers and many other vegetables are grown at Basrah and Amarah. Attempts were made to grow them higher up in 1916, but were frustrated by locusts. Excellent grapes are obtainable in July and August. Dates are available all the year round, but no one who has seen the local method of packing dates is likely to eat them again. Fowls and eggs are procurable in towns. Fish is also to be got, including, in the summer months, an excellent kind of sole. Weighted muslin or similar covers to protect food from dust and flies are essential.

Drink.—Chlorinated water is usually available for messes. River water, often the only kind available, is muddy and of course remains so when boiled. River water chokes Berkfelt and other filters very rapidly. A supply of powdered alum for sedimentation of water should be carried. Milk is generally obtainable on L. of C.—needless

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to say it should be boiled. Soda water is manufactured in the larger stations. Ice also is made.

Clothing.—In the hot weather many cases of heat-stroke occur. As a preventive, the head and spine must be adequately protected from the sun. For this purpose, spine pads and extensions for helmets are served out. Goggles are very useful. Ties are not worn in the heat of the day. In summer R.E. officers are allowed an Arab coolie as umbrella-bearer. Shorts should not be worn in summer unless your knees are impervious to insect bites. In winter it is rather too cold to wear them at night.

Sleeping.—A mosquito net is absolutely necessary for eight months in the year. About May it becomes necessary to sleep out of doors. The dews are very heavy and, if the top of your mosquito net is unprotected by another covering, sometimes drip through and wake you in a most unpleasant manner.

A pocket medicine case (*e.g.* Burroughs, Wellcome & Co.) is useful. Quinine should be taken regularly and also given to one's servants.

Mr. Dexter Davidson, a well-known Indian dentist, has sent a representative to Mesopotamia, and there is at least one local dentist in Basrah.

AMUSEMENTS.—Naturally there is little time at present for amusements, but the following notes may be useful :—

Shooting.—Small game is fairly plentiful, chiefly duck, partridge, snipe and sand-grouse. There is no big game. If you bring a gun, bring a whole season's supply of cartridges, as they are unobtainable in Mesopotamia, and it takes time and trouble to import from India.

Fishing.—There is plenty of fish in both rivers, the largest being 50 lbs. in weight. A large *mahseer* rod is therefore useful. *Atta* is the bait most generally used.

There are tennis courts at Basrah and Amarah. Polo has been played in one or two places. The desert is suitable for polo almost anywhere with very little preparation. The same remark applies to hockey, which is also played.

Bathing should be very cautiously indulged in owing to undercurrents. In mid-stream the current is usually much too rapid, and near the banks the mud renders bathing very unpleasant. The creeks are seldom deep enough and are usually the main sewers of the locality. Sharks are met with in the hot weather at least as far as Qurnah.

There are lots of pig in the marshes, and pig-sticking has sometimes been got up.

MISCELLANEOUS.—Postage to India and home is at present free, except for parcels and registered articles. Letters from home take

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about a month to arrive in Mesopotamia. Mails arrive once a week and there are occasionally interim mails to and from India.

There are two photographers in Basrah who will develop photos; one of these gets all films passed by the Censor.

If parcels are sent to you from home or India remember that anything in the nature of cake or sweets, even in hermetically sealed tins, is likely to spoil in the hot weather.

As far as I am aware, there is no comprehensive history of Mesopotamia from the earliest times to the present day. The Chandos Classics in the volumes on Persia and the Saracens deal with the periods when the Persians and the earlier Muhammadan rulers reigned.

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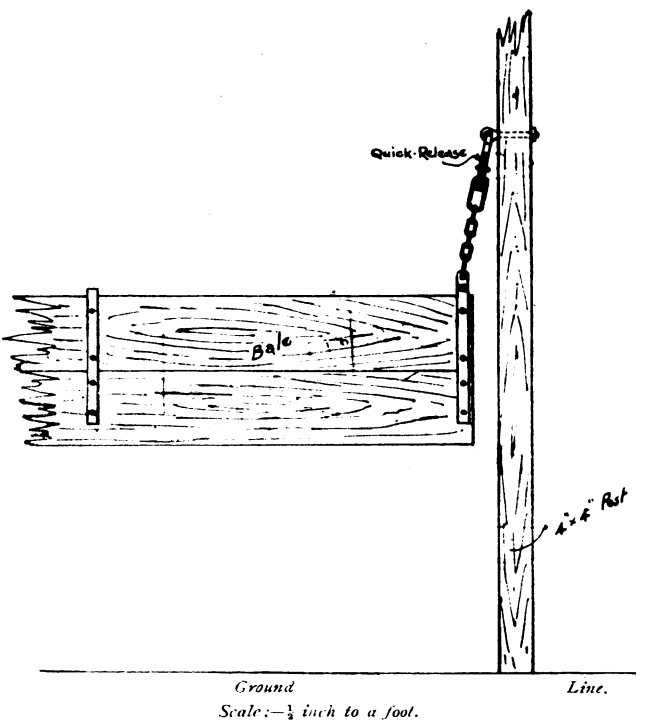
QUICK RELEASE FOR STABLE BALES.

By 2ND LIEUT. E. MARTIN, R.E.

THE following are the details of a quick release for stable bales in hutment stables which may be of value as a suggestion to anyone who has had trouble with horses getting their legs over the standard fixed bale usually provided.

The figures will, I think, fully explain the working of this release, which consists of a hinged hook with a sliding ring to keep the hook closed when the bale is in position. To release the bale the sliding ring is raised, the hook immediately opens by the weight of the bale, which is thereupon released.

This form of release has proved so successful that entire stables are being fitted out with them.



Sketch showing Bale held in position by Quick-Release.

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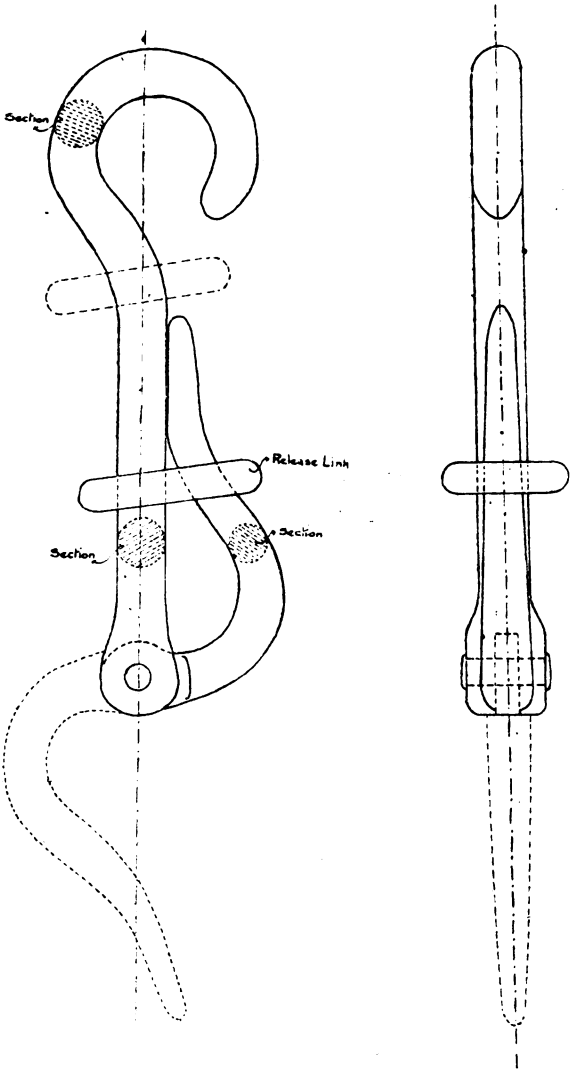
QUICK-RELEASE.
(*Half-size*).



Side View. *End View*

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KEADBY BRIDGE.

A PAPER was recently read by James Benjamin Ball, M.INST.C.E., at the Institution of Civil Engineers which described an important bridge over the River Trent at Keadby, about 14 miles north of Gainsborough, which the Great Central Railway Company have just completed. The chief feature is a lifting span, built on the Scherzer principle, which claims the distinction of being the heaviest lifting bridge yet constructed in Europe. The new bridge replaces the old swing bridge at Keadby which has carried the railway for over 60 years, and in addition carries a public highway in satisfaction of a long-felt want.

The new structure consists of a combined railway and roadway bridge of five spans of the following dimensions:—Two fixed river spans of 135 ft. each; a lifting span of 160 ft., giving a clear waterway of 150 ft.; a track span of 40 ft., on which the lifting span rolls, and an approach span of 70 ft. on the east bank of the river.

The bridge has a width of 53 ft. 6 in. between the centres of the outside girders, of which 29 ft. 3 in. is occupied by the railway and 24 ft. 3 in. by the roadway; each span consisting of three main girders, the centre one dividing the roadway from the railway.

The river piers, of which there are four, are faced with granite and founded on rectangular steel caissons filled with concrete and sunk under compressed air to a depth of 50 ft. below low water. The largest of these caissons has an overall length of 94 ft., a width over cutting edges of 20 ft. and a permanent height of 32 ft.

Difficulty was encountered in the early stages of sinking through one of the caissons tilting forward and moving bodily towards the river, which threatened serious results, but steps were taken which proved effective in arresting any further movement, and the caisson was finally righted during sinking in the new position it had taken up.

The two fixed river spans are similar in design, the main girders being of the ordinary N type, 17 ft. in depth, divided into ten panels and counterbraced in the two centre bays. The cross girders are suspended from the vertical posts below the bottom booms and spaced 13 ft. 6 in. apart; between them ordinary roadway and railway stringers carry the deck plating.

The top booms are connected by portal bracings at each vertical post, intersected by diagonal wind-bracing, and provision for

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longitudinal expansion is made at the junction of the spans by means of cast-steel bearings mounted on groups of rollers. The total weight of steelwork in each of these spans is 540 tons.

The three main girders of the track span form a path on which the lifting span rolls, and together have to sustain the weight of the lifting span, which is nearly 3,000 tons. These girders, which are of very heavy construction, have an effective length of 40 ft. and a depth of 10 ft., and carry on their upper flanges cast-steel plates, 3½ in. thick, on which the teeth are formed, engaging with corresponding slots in the segmental girders of the lifting span.

Considerable attention was given in the design of the bridge to the question of the contact pressures obtaining between the segmental girders and the track plates upon which they roll, and for the purpose of determining the probable arc of contact, careful experiments were made, particulars of which are recorded in the Paper.

The lifting span consists of three main trusses spaced at the same distances from one another as the main girders in the fixed spans, and taper from a depth of 36 ft. at the rear end to 18 ft. at the fore end. Cross girders, spaced 19 ft. 8½ in. apart, with longitudinal stringers between them, carry the deck plating of the road and railway respectively, whilst the upper booms of the trusses are connected together by substantial overhead portal bracing on each of the vertical posts, which, together with the wind-bracing above and the floor members below, tie the trusses together, thus securing rigidity in the span as a whole.

The lifting span is counterweighted at the rear end in order to secure balance at all angles of lift, the counterweight consisting of a rectangular steel shell extending across the full width of the bridge, and heavily braced internally by lattice frames and strengthening girders. Its internal capacity is 24,780 cubic ft., and it contains 1,800 tons of concrete.

Between the rear ends of the trusses and the under side of the counterweight, compound plate-web segmental girders having a radius of 28 ft. are provided. These girders have a central depth of 10 ft., and on their bottom flanges are bolted segmental plates of forged steel 3½ in. thick, provided with slots to engage with the teeth of the track plates on which they roll.

On either side of the lifting span heavy frames are built up alongside the track girders and anchored down to the supporting piers of the bridge. These frames at their upper extremity carry horizontal girders to which are bolted the main operating racks.

Between these frames sufficient clearance allows the span to move freely as the bridge is raised or lowered.

The position of the racks coincides with the centre of the rolling circle of which the segmental girders form part, and the rotation

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of the pinions attached to the gudgeon pins of the moving leaf as they travel horizontally along the racks, rolls the leaf backwards or forwards, so opening or closing the bridge. A horizontal platform at the level of the fixed racks is constructed on the leaf itself, and on this platform the lifting machinery is accommodated.

The total weight of steelwork in the lifting span is 987 tons, exclusive of the machinery and gearing, and the total weight of the moving span, together with its counterweight, is approximately 2,920 tons.

The lifting span is worked electrically by means of two 115-h.p. direct-current motors, carried on the leaf itself, the power being transmitted through trains of gearing to the main pinions on each side. The angle of maximum elevation of the bridge when fully open is 81°51, and the time taken to open or close it by electrical power is less than 2 minutes.

Owing to the absence of power in the neighbourhood, a special plant for the generation of current had to be put down, consisting of two direct-coupled petrol engines driving two 50-kilowatt continuous-current machines, the current being delivered at the switchboards at 220 volts. A large storage-battery is provided, capable of supplying the motors with current for about 30 operations of the bridge before recharging is necessary.

Two sets of electric brakes are provided, and at the fore end of the span two heavy forged steel bolts, worked electrically from the control cabin, engage with castings anchored down to the pier, so locking the bridge when in the "Down" position.

To prevent the too rapid descent of the leaf as it comes down on to the bearings, a pneumatic buffer is provided at the front of the span, whilst at the rear end bumping-clocks are provided on to which the counterweight comes down when the leaf attains its maximum elevation. Adjacent to these blocks, hydro-pneumatic buffers are fixed, the rams of which, coming into contact with the counterweight, bring the bridge gradually to rest as it reaches its final position.

In order to meet the requirements of the Navigation Authorities, the lifting span was erected in a vertical position, ten months being occupied in this work.

Electrically operated gates are provided for the protection of roadway traffic, which are interlocked with the railway signals, which latter, it may be observed, are what are known as three-position signals, and are the first to be installed as a complete scheme in this country.

Work was commenced in August, 1912, and following the Board of Trade tests which were carried out in March and April, 1916, the bridge was opened to traffic on the 21st May.

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REVIEWS.

PAGES D'HISTOIRE, 1914—1915.

(Librairie Militaire Berger-Levrault, Paris: 5, Rue des Beaux-Arts).

An announcement was made in the *R.E. Journal* for February, 1915, that the Librairie Militaire Berger-Levrault of Paris were publishing a series of interesting pamphlets in connection with the Great War; and in the *Journal* for that month and in subsequent numbers, reviews were published of pamphlets (numbered up to 40) belonging to this series. A further batch of these pamphlets, in continuation of the numbers already reviewed, has recently been received; the contents of the majority of these numbers are of as great interest as that of many of the numbers which have preceded them.

The 41st number of the series is entitled *The Poets of the War.* The poems, many of which have already appeared in the French Press, are preceded by a preface in verse by Hugues Delorme. The nature of the contents of the little volume may be gathered from the following lines of this preface:—

> "Vers d'espoir, de deuil, de révolte,
> Toujours sincères et touchants,
> Nous en avons fait la récolte
> Glanant parmi de vastes champs."

The volume contains some 60 poems, covering a wide range of subjects.

In a short poem entitled "Nos Alliés les Anglais" Maurice Allou tells us that before the War the Britisher knew not France and the Frenchman understood not the spirit of wild gaiety of the Briton. But since the days when the British and French commenced to fight side by side, the best that is in the souls of these two peoples suddenly revealed itself and enabled those of the island Kingdom and those of the great Republic to understand one another.

A poem by Emile Bergerat entitled *Jusqu'au bout!* contains a scathing denunciation of the modern Teuton, and in it is also expressed the determination of the Allies to persevere in the present struggle until victory is theirs.

Lucien Boyer in a few sarcastic lines entitled *La Dernière du Kaiser* deals with the propensity for prevaricating and telling downright untruths exhibited by German officialdom during the progress of the War. In the country of the Crown Prince and the Agence Wolff, says the poet, lying is a sport in the same way that golf is a sport in London. In a few lines addressed to His Majesty Albert I. the same poet tells of the honourable part played by Belgium in meeting her obligations as a Neutral State.

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Jean Rameau, in a short poem entitled *La Croix de Fer*, throws ridicule on the Iron Cross in view of the nature of deeds which have been deemed worthy of reward by its bestowal.

As might be expected, the now famous French "75" is specially honoured in verse. Two short poems, one entitled *Le Soixante-Quinze* and another entitled *Au* "75," appear in the collection, which concludes with a poem entitled *Les Belges* by Miguel Zamacoïs the last two verses of which are as follows :—

"Petit peuple martyr, pour ton apothéose
Tes ruines serviront de glorieux chantier :
Chacun t'apportera sa pierre, car ta cause
Est la cause du monde entier !

"En échange de tant d'héroïsme et de gloire,
Ta résurrection et ta prospérité,
C'est, payable comptant aussitôt la victoire,
La dette de l'Humanité !"

The 42nd, 45th, 49th and 53rd numbers contain the official communiqués, etc., sent to the Provincial Authorities by the Central Government ; they are the VIII. to XI. Volumes (inclusive) which deal with this subject—each of them covers the events of a complete calendar month commencing with February, 1915, and ending with May, 1915. Each of these volumes contain appendices, in which are given summaries of the principal events of the War during the month covered by the communiqués contained in the same volume.

The 43rd and 52nd numbers deal with mentions in despatches, and awards of the Legion of Honour and the Médaille Militaire, they are the IX. and X. Volumes of the series relating to these awards ; the 43rd number covers the period 26th November to 1st December, 1914, the 52nd number the period 2nd to 7th December, 1914, and the 56th number the period 8th to 11th December, 1914.

The 44th number of the series is entitled *German Hatred* (of the French) and contains impressions of Germany formed by Paul Verrier (of the Sorbonne), who tells that circumstances have permitted him to study the German thoroughly in his own home, since he has, during the past 30 years, paid many visits, extending from 2 to 17 months at a time, to Germany. During his sojourns across the Rhine, M. Verrier has come into close contact with Germans in all classes of society, but more particularly with the professors and undergraduates at the German universities. He tells us that he has never made enquiries from Germans as to their intentions or their feelings towards France, as this would have been futile, the adoption of such a course could only have ended in mutual deception. On the other hand, M. Verrier has been keenly observant in regard to matters concerning his own country coming under his notice ; the impressions created in his mind, during his intercourse with Germans, have enabled him to form a pretty shrewd opinion on their mentality. He tells us that when he first left his own home for Germany, in 1878, his sympathies inclined strongly in favour of that country ; fostered no doubt by the study

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he had made of German literature, such as *Faust, Werther, William Tell, The Brigands*, etc. The War of 1870 caused no bias in M. Verrier's mind against the Germans, as he had been brought up to believe that the war in question had been caused by the insatiable ambition of Napoleon III.

He claims too that he is an out-and-out Socialist, an anti-militarist and an internationalist, and further tells us that he consoled himself with the idea that some day Germany would repent her act of annexing Alsace-Lorraine and voluntarily restore these provinces to her neighbour.

The last sentence describes M. Verrier's frame of mind in 1884, when he set out again from France to take up the post of language master in an English school at Heidelberg. He took advantage of his stay in the town last mentioned to matriculate at its University, and at the same time joined one of the well-known Students' Associations. M. Verrier speaks of the drinking bouts and duelling habits of the 'Varsity students in no approving spirit; indeed, he appears to have been most unfavourably impressed with the manners and conduct generally of his fellow students.

Some years later (1892—1893) M. Verrier, having won a travelling scholarship, revisited Heidelberg to study the various German dialects. He describes the unpleasant experiences he went through when attending, by special request, meetings of the Students' Associations. On these occasions, the strong anti-French feeling which existed in Germany was forcibly brought home to him. He sought an explanation of this attitude from one of the professors of the University, who had been a fellow student with him in 1884—1885. He was informed by the professor that there was no real patriotism in Germany, so that in order to foster the unity of the German Empire the idea had been hit upon to make it dependant on a hatred common to all its people. This was unfortunate, but it was necessary.

Other aggravating incidents are referred to in connection with this and subsequent visits to Heidelberg in which M. Verrier, his wife (a German by birth) and a son (aged 14 years) experienced, at the hands of educated German people, the bitterness of the hatred against France, a hatred which appears to have been instigated and kept alive in Germany both from the pulpit and the professorial chair. M. Verrier reminds us that according to Arndt, "That is the German Fatherland, where every Frenchman is called an enemy."

M. Verrier gives examples of the manner in which the policy of engendering hatred of the French has been encouraged in Germany, by ridiculing the French in cartoons; by calling attention of the pupils in the schools to the alleged misdeeds of the French; by taking the opportunity, on the occasions of the delivery of patriotic speeches in celebration of the anniversary of German victories, of pointedly disparaging the French, etc.

He points out also that German school books are written with the deliberate intention of developing a chauvinistic spirit in the youth of the Empire; the doctrine that an obligation and a duty rests upon every German to work towards the attainment of German hegemony is openly advocated in these school books—the crushing of France,

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being represented as the first step necessary in order to secure German supremacy.

M. Verrier also passes in review the general literature which has issued from the German Press during the past few decades; in view of the teachings contained therein there is little wonder that the mental balance of the German people has been so completely upset as to cause them to think that they had attained such pre-eminence as a governing Power as to entitle them to dominate the whole world.

The 46th number is entitled *Switzerland and the War*. The editors, in an introduction to this volume, state that the attitude of the "Little Sister Republic" in connection with the War has been an enigma to many Frenchmen. In the first days of the War, it was thought that Switzerland would throw in her lot with the Entente Allies on principle, in order to fight with those who were defending right and liberty. Later, it was expected that the Helvetic Republic would lodge a protest against the violation of the neutrality of Belgium. But nothing happened and the reason for Switzerland's silence and inactivity is explained by her leaders to be due to the fear that any protest which the Republic might have entered would certainly have been considered by the Germans as a sufficiently provocative act to justify the same treatment of Switzerland as was meted out by them to Belgium; further, it is argued, the Republic was under an obligation imposed by treaty to remain outside the conflict, unless attacked. Another reason for her attitude lay in the fact that no other neutral, neither the powerful United States of America nor the deeply concerned Italy, officially raised its voice on behalf of Belgium.

Switzerland also found itself faced with an internal crisis, owing to the sympathies of her people being divided, some inclining to one and others to the other belligerent group. The internal situation was so grave at one time as to jeopardize the very existence of the Republic, and it was only due to the perspicuity of true patriots that the Ship of State was steered into relatively smooth waters.

It is for these reasons that the Federal Council took no further step, in the first days of the War, than that of mobilizing 320,000 out of the 480,000 men enrolled in the Swiss Army.

In the volume under review, the editors have collected together a few characteristic contributions to the foreign Press; from a perusal of the contents some idea can be obtained of the difficulty of the problems which have faced the Swiss people and their leaders. The volume opens with the text of the declaration of neutrality issued by the Federal Council on the 3rd August, 1914; some of the views held in the French-Swiss and German-Swiss camps are next reproduced; the speech made by Mr. Henri Fazy, the doyen of the National Council, at its meeting held on the 6th December, 1914, follows; and the volume is brought to a close with a brief reference to the many ways in which the Swiss have come to the assistance of the victims of the War.

The contents of this volume show clearly enough that the outrageous acts of the German Army in Belgium have been strongly condemned, both in the French-Swiss and in the German-Swiss camps. On the other hand, the racial divisions in the Republic are an insuperable

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obstacle to common action on the part of the whole people in a case which involves intervention in a quarrel to which France and Germany are parties.

The 47th number of the series contains the diplomatic correspondence, in relation to the crisis, preceding the outbreak of the present war, published in the Austro-Hungarian Red Book. The volume comprises 69 despatches, some accompanied by appendices, and covers the period 29th June to 24th August, 1914. These despatches are preceded by an introductory memorandum setting out Austro-Hungarian grievances against Serbia. Reference is made to the bitter feeling created in Serbia, in consequence of the annexation by Austria of Bosnia and Herzegovina, and it is alleged that since the advent of the Karageorgevitch dynasty on the Serbian throne deep-laid schemes, of which revolutionary intrigues have formed a conspicuous part, have been set on foot in Serbia with the object of inducing the Slav races resident in the southern territories of Austro-Hungary to break away from the Dual Monarchy.

The situation is said to have become so intolerable that it was no longer possible for Austro-Hungary to live in peace and on a neighbourly footing with Serbia, as was the case in the time of the Obrenovitchs. The despatches disclose that, in spite of the serious warning which was given to Austria, in July, 1914, by Great Britain and by Russia that the course she was pursuing in relation to Serbia would plunge the whole of Europe into a disastrous war, she pushed aside all offers of mediation. The despatches indicate that Austria and Germany were both well aware of the dangers of the situation created by the terms of the ultimatum sent to Serbia, quite apart from the warnings just referred to; however, it is probable that confident in the prowess of their armies and misled by outward signs of weakness in the political situation in Great Britain, France and Russia, the Teutonic Powers carried their "bluff" too far, and thus became responsible for the great calamity which has overtaken the world.

The 48th number is entitled *The Campaigns of* 1914. In a preface, the editors tell us that the contents of this volume are a reproduction from the *Illustration* of three articles by a distinguished officer, who writes under the *nom de plume* of Champaubert. These articles are illustrated with 23 sketch maps on which the positions of the contending armies, at various dates, are marked. The first of the articles deals with the Western Theatre of Operations; a very brief examination of the strategical relations of France and Germany is first made, attention being drawn to the circumstance that the measures adopted by the two countries since the new frontier between them was laid down in 1871, made it practically certain that in waging an offensive war Germany would attempt the invasion of France by causing the bulk of her forces to traverse Belgium and the Grand Duchy of Luxemburg. An outline is next given of the actual plan of concentration adopted by the British and French Armies on the front Condé–Binche–Maubeuge–Mezières–Toul–Mt. Donon–Belfort and by the German Armies on the front Aix-la-Chapelle–Metz–Strassburg–Belfort. The early engagements in Belgium and France are referred to and the difficult position in which

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Castelnau found himself on the 20th August, 1914, when attacked not only on his front by the German Army under the Crown Prince of Bavaria, but threatened also on both flanks (from Metz on the left and by the VII. German Army under von Heeringen on the right) is touched upon. Castlenau, as is well known, prudently decided to retire, and finally fought the Germans to a standstill on the line Grand Couronne (Nancy)-La Montagne. In dealing with the general retirement of the British and French Armies to conform with the rearward move of the 3rd and 4th French Armies, when they were pushed back by powerful German columns in Belgian Luxemburg, Champaubert points out that it was open to the French generalissimo, at that time, to have chosen to make a stand in an entrenched position either behind the Meuse or the Aisne. Joffre was clever enough fully to realize that the adoption of a commonplace expedient of this kind would only delay the hour of eventual defeat and wisely decided on the bolder course of falling back behind the line Paris-Verdun, so that when the Germans had heedlessly followed him into the gap between the two places named, the Allied Armies came to a stand and turned vigorously on to their assailants, both of whose flanks were now threatened from the fortresses between which they had penetrated without due precautions. The victory of the Marne and the fighting on the Aisne is next briefly described. This article concludes with a reference to the so-called Battle of Flanders and the comparative calm which succeeded it.

The second article is entitled *Six Months' War in Poland.* It opens with some remarks on the military organization of Russia. It is pointed out that the reorganization of 1910 provided Russia with 27 Army Corps (in place of 24 Army Corps as was the case previously) ; it should be noted that at the same time the number of Army Districts was increased from six to seven—the headquarters of these districts being located at Petrograd, Vilna, Warsaw, Kieff, Odessa, Moscow and Kazan.

The Eastern Theatre of Operations and the plans of campaign are next described. It is pointed out that the Great General Staff at Berlin had decided to leave three Army Corps on the eastern frontier of Germany to act as a defensive force during the first weeks of the War, whilst the whole of the Austrian Army, not detailed for the operations against Serbia, was intended to take the offensive against Russia and to attack her vigorously in order to interfere with the mobilization of her Army. The Russian Army early in the War had to act in such a way as to compel Germany to transfer a large part of her Army employed in the Western to the Eastern Theatre ; this required prompt and vigorous action against Germany. The same urgency was not necessary in relation to the action to be taken against Austria ; it was sufficient to contain the Austro-Hungarian forces until such time as Russian troops from the more distant parts of the Muscovite Empire could be brought to Poland.

The early operations in Prussia are touched upon ; in that region the Russians effected the purpose the Russian General Staff had in view in invading German territory, although unfortunately the Russians had to withdraw after von Hindenburg's success at Tannenburg, towards the end of October, 1914.

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The operations in Galicia are next briefly described and short accounts are given of the first offensive stroke against Warsaw and the second invasion of western Poland by the Teutonic Armies. This article concludes with a description of the situation in this theatre in June, 1915.

It is pointed out that at this time Russia had succeeded in drawing against herself one-third of the German Army and three-fourths of the Austrian Army Corps and by far the greater part of the Turkish Army. To the effect produced by Russia's blows was it due that internal dissensions were created within the Dual Monarchy and that the Germans were obliged to suspend their march on Paris and Calais.

The third article deals with the campaign in Serbia. It is pointed out by Champaubert that Count Bertchtold talked nonsense in accusing the Belgrade Government of complicity in the Sarajevo crime. Had Serbia really wished to provoke an enemy to extremes, she could not have chosen a worse time than that of the murder of the heir to Austria's throne for the purpose. The two wars she had recently waged had completely impoverished her in men, material and money, thus making her quite unfit to prosecute a third war within a decade. A scheme had been prepared for doubling the Serbian Army, *i.e.* of increasing the divisions from five to ten, but little progress had been made with the reorganization in question; so that the delivery of the Austrian ultimatum took Serbia completely by surprise.

A short description is given of the Serbian and Austro-Hungarian Armies. In the case of Serbia the Army consisted of :—

(*a*). The first Ban (men between 21 and 30 years of age) which comprised five divisions (of all arms), one cavalry division, together with mountain and heavy artillery.

(*b*). The second Ban (men between 30 and 38 years of age) which also comprised five divisions (of all arms); the divisions were however weaker than those of the first Ban, viz. :— three regiments of infantry instead of four and 12 guns instead of 36.

(*c*). The third Ban (men between 38 and 45 years of age), which was only a militia; each military district furnished one regiment of infantry and one squadron of cavalry.

(*d*). The Comitadjis, which was an irregular Corps.

On mobilization the Serbian Army numbered 400,000 all ranks.

The third Ban of the Serbian Army was distributed along the rivers Drina, Save and Danube and formed a strategic outpost line covering the main body about Aranguelovatz—this town is midway between the two probable theatres of operations in which the Serbian Army was likely to be engaged.

Two-thirds of the Army of the Dual Monarchy was obliged to proceed to Galicia. The Austrian plan of campaign contemplated demonstrations along the Danube and lower Save by the VII. Army Corps and units of the Honved Army and of the Landstürm, at the same time the real attack was to be delivered from the line of the Drina and the region where this river joined the Save. Five Army Corps were detailed for

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the real attack, whilst a part of a sixth Army Corps was to remain as a reserve in the fork of the Drave and the Save.

A short description is given of the Battle of the Iadar in which the Austrians were driven back towards the Drina. Mention is next made of the fighting on the Drina and of the Battle of Roudnik; the Austrians were successful in these operations, and, in view of the risk the Serbian Army ran of being enveloped, its commander decided to retire eastward. During this retirement, the Serbians frequently halted and turned on their pursuers, generally with success. However, they finally evacuated Belgrade and on the 2nd December, 1914, their line extended from the heights of Drenie (on south bank of the Danube) along the heights of Kosmaï and Roudnik to the left bank of the Morava near Pojega. On the day following that last mentioned, the Austrians ran into the Serbian Army, which was hidden by a mist, at Roudnik and were badly beaten and driven back to the Drina. On the 15th December, 1914, King Peter re-entered his capital and on that date not a single armed Austrian remained within his kingdom.

The 50th number is entitled *Our Sailors and the War* and deals with the War at sea in diary form; this volume covers the period 4th August, 1914, to 27th March, 1915. In an appendix there have been included a series of short notes on matters of special naval interest, such as the fate of the German Colonies, the submarine in modern war, the Allied fleets in action, the North Sea Battle, the German naval bluff (*i.e.* the submarine blockade of the British Isles) and the submarine attack on the *Jean-Bart.*

The 51st number of the series is a reproduction (in French) of the Second White Paper issued in connection with the War and consists for the main part of the despatches which passed between the British Foreign Office and the British Ambassador to the Sublime Report in relation to the attitude of Turkey. These despatches cover the period from 3rd August to 4th November, 1914, and begin with a despatch from Sir Edward Grey to the British Representative at Constantinople requesting him to inform the Turkish Government that the British Government had decided to take over the warship *Osman I.* which, at that time, was under construction for the Turkish Navy in the yards of Messrs. Armstrong, Whitworth & Co. Subsequent despatches deal with the arrival of the *Breslau* and *Goeben* in Turkish waters, the steps which the British Government took to prevent Turkey falling completely under the control of Germany and Austria, the interference by Germany, as well as by Turkey, with British shipping in neutral waters, the intrigues set on foot by these two Powers to jeopardize the position of Great Britain in Egypt and other Mohammedan countries, and finally, the acts of war carried out by Turkey against Russia at Odessa and Theodosia, which eventually caused the rupture of diplomatic relations and resulted in the Turkish Army becoming a tool in the hands of the Teutonic Powers for the purpose of continuing their policy of World Conquest.

The 54th volume is entitled *The Economic Causes of the War.* The contents of this volume are from the pen of Christian Cornélissen, a well-known Dutch Sociologist. An Introduction to this volume by

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M. Charles Andler of the Sorbonne deals with the German menace to Holland. A brief reference is first made in this Introduction to Cornélissen; we are told that he was at one time a teacher of Natural Science at Gertruidenberg, but in 1891 renounced teaching for journalism. Cornélissen has since the date mentioned associated himself closely with the cause of Labour, and, in order to study closely the lot of those whose cause he had espoused, followed the trade of a painter and decorator. He has been settled in France for some time and is the author of a number of works on Social Economics. In dealing with the German attitude towards Holland, M. Andler points out that Germany covets those regions in Europe in which lie the delta of the Rhine, as also the Dutch Indies and Dutch Guiana. Moreover Holland is guilty of a grave wrong, in Teutonic eyes, in that she no longer forms part to-day of the German Empire as in the days of the Holy Roman Empire. It has been the dream of several eminent publicists—some of these are quoted by M. Andler—to constitute in their own day a powerful confederation, in which it was desired to unite with the present German Empire, Austro-Hungary, Switzerland, Belgium and Holland. The formation of such a Central European Confederation met with the approval of the German Socialists, some of whom further have made it no secret that it was the aim of International Socialism to upset the dominant position occupied in the affairs of this world by Great Britain.

Cornélissen was not willing to be a party to these mad schemes. He looks upon the Western people as a force united into one vast Syndicate for the promotion of freedom, and, in consequence he has espoused their cause and has been engaged in the propagation of his own belief on this subject among his Dutch compatriots.

M. Cornélissen's contribution is divided into four sections, the first of which deals with the causes of the War. It is pointed out that all visitors to Germany, in recent years, have noticed the remarkable change which has come over the people of that country in the last few decades and the rapidity with which the country has developed economically. It is said that Germany recovered from the acute crisis of 1907—1909 more rapidly than the United States of America—figures to prove this are reproduced from the *Frankfort Gazette*.

The rapid increase of the population of the German Empire during the present century has been a powerful factor contributing to its economic expansion. And at the same time, it was this increase of population which was also responsible for the desire which had grown in Germany for territorial expansion, a desire which has been pointedly referred to in the phrase: "Antwerp and Rotterdam are the lungs of Germany in the west."

Those who had made a careful study of the economic situation in Germany were convinced that it was one which tended to provoke a war of conquest. It is pointed out that Germany found herself, just before the War, in a situation analogous to that prevailing in Great Britain at the time that machinery was introduced into the latter country and she went in search of new markets in which to dispose of the products of her factories. Great Britain, however, being first in the field, was able to monopolize the markets of the world without having

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to push out any rivals. Germany, on the other hand, had not only to compete against Great Britain, but also against the United States of America, which is to-day first and foremost in commercial and industrial enterprises, as well as against France, Russia, Italy and Austro-Hungary. In every direction Germany has found obstacles which have prevented her from having a free hand in placing the output of her factories.

Cornélissen points out that the Press of the world has dinned it into our ears during the past few months that the present war is a fight between Great Britain and Germany for world domination in the fields of commerce and industry. Those who express themselves in these terms reduce into simple language an extremely complicated situation, but they forget to lay stress on the fact that Great Britain is acting on the defensive in order to retain a position she has already won and that she possesses colonies all over the world with which she has close commercial relations; and therefore it has not been from Great Britain that the dangers of a world-wide war threatened Europe during the past decade. Events have also proved that France was not ready for a great war. On the other hand, Germany has wanted to supplant her rivals, on the right hand and on the left, in international markets. Consequently, although the attitude of Great Britain has been defensive that of Germany has been distinctly offensive.

The question is next discussed as to whether the last financial crisis in Germany may not have accelerated the date for the outbreak of the war which is now in progress. The conclusion arrived at is that the economic situation in Germany was not, during the first half of 1914, altogether favourable to a declaration of war by her and therefore it must have been political and technical considerations which induced her to adopt the course she took in July, 1914. Cornélissen is of opinion that it is a mistake to attribute the outbreak of war solely to the German capitalists as a class; he points out that capitalists were well aware that a declaration of war by Germany against France and Russia would mean the ruin of thousands of their own class; the possibility of personal losses had to be faced by each of them.

The second section of the volume deals with the economic struggle; the racial struggle; and the battle of governmental régimes. Cornélissen states that those who desire to probe for the causes of the Great War must not confine their attention exclusively to the material gains which are likely to benefit certain individuals or certain classes. Taking it for granted that Germany had a greater responsibility than any other nation in bringing about the present war, it is less clear, says Cornélissen, that this responsibility can be placed solely on the shoulders of some of the great capitalists interested. All the wars of recent times, it is true, have been waged in the interests of capitalists, but the present war is one rather in the nature of a *racial struggle* and a *battle of governmental régimes* rather than a *war of material interests*. The assassination of the heir to the Austrian throne and his consort was, it is quite evident, only used as an excuse for justifying the adoption of a course already decided upon for quite other reasons. The struggle for the supremacy of Germany in Europe is not limited, Cornélissen tells us, to domination in the sphere of economics alone, but extends to domination in matters

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affecting politics, as also those affecting the intellectual and moral outlook of the peoples over whom it is desired to establish German Overlordship. It is further intended that the hegemony of German "kultur" shall embrace the whole of Europe.

Had not the Trades Unions in Germany, or at least the Labour leaders, been almost all Pan-Germanists and Imperialists it would not be possible, as is really the case, for anyone to speak of the "bankruptcy of International Socialism." The workmen of Germany and their leaders were evidently of opinion that their interests were as closely bound up in the extension of German domination and in the policy of colonial expansion as that of the ruling classes.

The third section of the volume deals with *The Duties of Western Europe.* The present war, says Cornélissen, imposes a double duty on the democracies of Western Europe; firstly, they must oppose a war of conquest, a war waged to bring about an extension of the territories of the industrial states of Central Europe; secondly, they must fight against the continuance of autocracy and against the Pan-German reaction in these same States which have led them into the present conflict.

Cornélissen points out that intellectual and moral Pan-Germanism constitutes a dire peril for countries enjoying the advantages of democratic government.

The fourth section of the volume deals with *The United States of Europe.* Cornélissen urges that the peoples of Western Europe should continue their resistance against the avalanche of the Austro-German Armies with energy and to the bitter end, in order that the defeat of Prussian imperialism and militarism may enable us to advance another step towards the creation of the United States of Europe; in Cornélissen's opinion, the European Powers ought to form themselves into a Confederation in which the autonomy of the different nationalities would be respected and where arbitration would be substituted for armed conflicts to settle disputes between the States forming the Confederation.

Although a century may elapse, Cornélissen thinks, before Republics can be founded in Germany and in Austria, yet in his opinion the armies of France can at least establish in Central Europe the principles of the supremacy of the civil power over that of the military, of lay and democratic influence in place of the sway of the priest and the squire.

He has little doubt in his mind, if this were done, that the armies of the Western Allies would be received with open arms by the vast majority of the more intelligent among the German peoples; he is even convinced that with a little goodwill on all sides a situation could be brought about in Europe which would secure permanent peace by the removal of all disturbing causes likely to bring the economic and other interests of the several States of the Old World into conflict.

The 55th number of the series contains the diplomatic correspondence published in the Italian Green Book dealing with the circumstances which led to a rupture of relations between Italy and Austria-Hungary last year. The despatches, of which there are 77, cover the period 9th December, 1914—4th May, 1915. The first despatch of this series

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gives the text of the instructions sent by the Italian Minister for Foreign Affairs to the Italian Ambassador at Vienna. In this despatch the latter is directed to inform Count Berchthold that the Austro-Hungarian attack on Serbia was an event which made it necessary for the Italian and Austro-Hungarian Governments to discuss preliminaries in accordance with Article VII. of the Triplice Treaty. The Article in question, he was directed to point out, rendered it obligatory on the Austro-Hungarian Government, even in the case of a temporary occupation of territory outside the limits of the Dual Monarchy, to enter into an agreement on the subject with the Italian Government and at the same time to settle what compensation the latter should receive. Further, the attention of Count Berchthold was to be called to the fact that Austria-Hungary had, in virtue of the provisions of Article VII., restricted the operations of the Italian Army during the Italo-Turkish War; and in the case of the Italian naval operations in the Dardanelles, the Dual Monarchy had entered formal protests. The Italian Ambassador was also requested to explain that Italy considered it a matter of paramount interest to her that the territorial integrity and the political and economic independence of Serbia should be completely preserved, and that Article VII. gave Italy a right to compensation even in the case where the advantages obtained by Austria-Hungary did not consist in new territorial acquisitions. The state of public feeling in Italy on this matter was to be made clear and at the same time the desirability of removing every pretext for regrettable incidents and suspicions as to the designs of the Dual Monarchy was to be urged.

The despatches show that, from the first, Count Berchthold was not prepared to discuss the question of the interpretation of the terms of Article VII. with the Italian Government, and an attempt was made by him to differentiate between the situation of Italy at war with Turkey and that of Austria-Hungary at war with Serbia so far as the applicability of the provisions of Article VII. were concerned.

In a despatch from the Italian Foreign Minister to the Italian Ambassadors at Berlin and Vienna, dated 20th December, 1914, the former announces that Prince von Bülow had paid his first call at the Foreign Office, Rome; the object of von Bülow's visit to Italy, at that juncture, was stated to be a desire to familiarize himself with the mentality of the Italians, and to make the same known to the German Government. Von Bülow, it would appear, led the Italian Foreign Minister to believe that, in the controversy which had begun between Italy and the Dual Monarchy, he was of opinion that the former country was in the right. However, after much correspondence the two Powers were not arriving near any basis of agreement. Austria-Hungary had it was true accepted the principle of territorial compensation to Italy in return for an undertaking that the latter should remain strictly neutral throughout the War. But the territories which were to be assigned to Italy by Austria-Hungary belonged to third parties and not to Austria or Hungary, and therefore there was no guarantee that the Dual Monarchy would ever be able to carry out her bargain, even if Italy were prepared to agree to her terms, which as a matter of fact she was not.

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On the 4th March, 1915, the Italian Foreign Minister telegraphed to the Italian Minister at Vienna that it appeared to be useless to prolong the discussion with the Austro-Hungarian Government on the question of territorial compensation on the basis of Article VII. In this despatch the negotiations which had already taken place between the two governments are summarized in the following terms :—

1. That no military action should be commenced by Austria-Hungary in the Balkans until an agreement had been arrived at with Italy on the subject of compensation; Italy would hold Austria-Hungary strictly to the provisions of Article VII.

2. That every breach by Austria-Hungary of the principles laid down in the preceding paragraph would be considered a flagrant violation of the Triplice Treaty, leading to a denunciation of the Treaty by Italy, in order that she might resume full liberty of action for the protection of her rights and interests.

3. That no proposals or discussions regarding compensation on the part of Austria-Hungary would be considered by Italy unless the same related to the cession of territory forming part of the Dual Monarchy.

4. That, in view of the provisions of Article VII., Italy demanded compensation by reason alone of the fact that Austria-Hungary had undertaken military operations in the Balkans, and quite apart from the results which might follow upon such action.

5. That the compensation to be awarded Italy in respect of the military operations commenced in the Balkans by Austria-Hungary was not to be a matter to be kept secret, but must take effect in the immediate surrender to and occupation by Italy of the territory ceded.

6. That Italy was not prepared to enter into the discussion of any question of compensation to be made by her to Austria-Hungary in respect of her occupation (at the time of the Tripoli Campaign) of the Dodecanese Islands and Vallona—this matter had been raised as a counter-claim by Austria-Hungary.

Negotiations, however, were not at once broken off by Italy. The Italian Foreign Minister with infinite patience and admirable skill renewed the Pourparlers; during these further discussions von Bülow from time to time appeared on the scene, but was not able to divert Italy from her purpose. It was not till the 3rd May, 1915, that the patience of Italy was finally exhausted and instructions were sent from Rome to the Italian Ambassador at Vienna to leave with the Austrian Foreign Minister the copy of a despatch reviewing the circumstances in which Italy had entered into an alliance with Austria-Hungary as a mutual measure of defence and for the purpose of securing peace. The violation of the terms of the Treaty of Alliance by Austria-Hungary is referred to in the despatch in question; the despatch concludes as follows :—

"Under the circumstances, the Italian Government must give up all hope of coming to an agreement in respect of the matters in dispute and feels bound to withdraw all the proposals put forward by it as a basis of agreement.

"It is equally useless for Italy to endeavour to maintain the appear-

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ance outwardly of an Alliance, which can only result in dissimulating the existence of mutual distrust and daily differences.

"For this reason Italy, having confidence in the justice of her case, affirms and proclaims that from this time forth she resumes her entire liberty of action and declares her Treaty of Alliance with Austria-Hungary annulled and of no effect."

The concluding despatch is one from the Italian Ambassador to the Italian Foreign Minister dated 4th May, 1915, reporting that he had carried out the foregoing instructions.

W. A. J. O'MEARA.

STRESSES IN WIRE-WRAPPED GUNS AND IN GUN CARRIAGES.

By LT.-COL. COLDEN L'H. RUGGLES.—(London : Chapman & Hall, Ltd.).

The fact that a second edition of this work has been found necessary, shows that it supplies a considerable demand, and we are sure that the ordnance student, as well as the practical designer, will find the book of much value. Probably it is more specifically adapted as a class-book for the cadets at the United States Military Academy, for whom it was originally written. As to the engineer capable of following the mathematical discussions in Chapter III., the first part of Chapter IV. dealing with Bending Moments, Moments of Inertia, etc., and the greater part of Chapter V., would be a mere repetition of familiar theory.

Chapter I. deals with stresses in "Wire-wrapped" guns and is based on Lissak's *Ordnance and Gunnery*. We are glad to note the inclusion of a fully-worked example which is made particularly clear by excellent diagrams.

Chapters II. and III. are devoted to the determination of the forces in the parts of a 3-in. field carriage and a disappearing gun-carriage respectively, but a working knowledge of the calculus is necessary to follow the mathematical parts in the latter chapter.

The latter section of Chapter IV. is concerned with a discussion on the "stresses in parts of gun-carriages" and again worked examples are used to make this clear. We consider this one of the best parts of the book.

Chapter V. deals with Toothed Gearing partly with reference to guns and Chapter VI. with "Counter-Recoil" Springs or, as more commonly called in this country, "Running-Out Springs" in which some useful information from the designer's standpoint is given.

The general get-up of the book is good and the text clear. We are a little disappointed that the author does not give more details for design but possibly in its present form it is better suited for the use of the student.

We can recommend the book to all interested in ordnance.

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NOTICE OF MAGAZINE.

REVUE MILITAIRE SUISSE.

No. 9.—September, 1916.

IMPRESSIONS FROM THE AUSTRO-HUNGARIAN FRONT.

II.

In Serbia with General Kövess's Army.

The article under the above heading begun in the number of the *Revue* for August, 1916 (*vide R.E. Journal* for November), is continued in the number now under review.

The Capture of Belgrade.—The author of the *Revue* article points out that the attack made on Belgrade by the Austro-German heavy artillery on the 5th October, 1915, from the neighbourhood of Semlin, on the left bank of the Danube, took the Serbians by surprise; for a whole day the latter made no reply to the hostile artillery fire.

The progress of the Austro-German attack is briefly described in the *Revue* article. The first body of troops to get across the Danube was the 87th Austrian Regiment, which set foot on Serbian soil about 5 a.m. on the morning of the 7th October. No sooner was this regiment across the river when the Serbian batteries at Kalimegdan and Vracar at once opened fire on the enemy; some transports on the river were sunk, and the operation of crossing the Danube was interrupted.

On the 7th October, heavy artillery fire was brought to bear by the Austrians on the defences of Belgrade. As a result the four 150-mm. French guns at Kalimegdan were silenced one by one and the Serbian searchlights were also put out of action. In order to provide a substitute for the searchlights, the Serbians purposely set fire to factories near the railway station: the conflagration caused thereby brilliantly illuminated the banks of the Danube and of the Save for two days.

However, in spite of the violence of the Serbian bombardment, Austrian and German troops succeeded in forcing the passage of the river and in entering Belgrade; finally, the Serbians retired in a southerly direction and took up a position on the heights north of the line Zarkovo-Dedinje-Veliki-Vracar.

The Siege of Belgrade lasted five days. The Serbian General Staff had remained completely in the dark concerning the concentration of General Kövess's Army between Semlin and Orsova. The three French aviators, who had been stationed at Belgrade, had been sent to Salonika in September; the Serbian detachments along the Danube and the Save had not reported that anything unusual was happening on the banks of these rivers held by the enemy.

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The Serbians had counted on considerable assistance from the Western Allies, but all they received was one battery of artillery from the British and one from the French.

In spite of the disadvantages under which the Serbians found themselves they fought with great heroism, and stubbornness.

In spite of the fact that the old citadel of Kalimegdan was antiquated —having been constructed on the Vauban system in the 17th century— it proved a considerable obstacle to the Austro-German advance until it was finally reduced by artillery fire.

The writer of the *Revue* article speaks in high terms of praise of the fighting qualities of the Serbian Army. The Serb, he says, makes a first-rate soldier. Further, he has often heard Austro-Hungarian officers speak in high admiration of the military qualities of the Serbian soldier. The Serb is generally a man of medium height, of a blonde type with a tanned skin ; a Slav of the south, he is quicker witted and more free and easy than his Russian cousin. Serbian soldiers possess all the qualities of a peasant race, namely, untiring patience, faithfulness, bump of locality, respect for authority and a devotion to their native land that leads to the performance of heroic deeds.

It is said that between the victorious campaign of 1914 and the less fortunate one of 1915, the quality of the Serbian soldier had deteriorated. This alleged deterioration has been attributed to the following causes :—

(*a*). The epidemic of typhus which carried off 30,000 soldiers.

(*b*). The losses in the campaign of 1914, which have not been made good by the 120,000 recruits of the 98—99 class since enrolled ; 60,000 of these recruits were of the newer nationalities incorporated into Serbia, *i.e.* Macedonians, Bulgars, Albanians, Turks. The recruits last referred to fought without enthusiasm, many surrendering whilst others deserted.

(*c*). During the 1914 campaign, the casualties in the ranks of the officers of the active army amounted to 60 per cent. of their number. These losses had to be made good by calling up Reserve officers, who had received little military instruction.

(*d*). Four years of continuous war had exhausted the country.

(*e*). The numerical superiority of the enemy opposed to them.

(*f*). The lowering of *morale* caused by the failure of the Western Allies to come to the assistance of Serbia in her hour of great need.

(*g*). The lack of heavy guns. The Serbs had only 6-in. guns with which to reply to the terrific fire of Austro-German 12-in. and 16·5-in. guns.

(*h*). The lack of aviators.

The effective strength of the Serbian Army was, in October, 1915, about 220,000 men.

The Pursuit of the Serbians.—After the fall of the Serbian capital General Kövess's Army attempted to push forward at once as quickly as possible in order to make the bridge crossings over the Danube and the Save secure and to prevent a Serbian counter-stroke against Belgrade.

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The Austrian and German forces having joined hands, they attempted to seize the heights of Avalla—about 12½ miles from Belgrade and separated from it by a plain, which is highly cultivated but devoid of woods. Owing to the resistance of the Serbian army many days elapsed before the Austro-German troops could take possession of the heights of Avalla. In their further progress southward the troops of the Central Powers were stubbornly opposed by the Serbians, who made excellent use of the ground to delay the advance of the Austro-German forces.

The Serbian soldiers were very indifferently armed and equipped. They were armed with Mausers, rifles captured from the Turks in 1912, Russian rifles, etc.; the regiments of the first ban had proper uniforms and equipment, but in the case of the second ban, the men had been issued with a variety of different uniforms, some men were wearing French jackets, others had on British greatcoats, etc.

The Serbian artillery was handled with great skill and boldness. However, the effect produced by the heavy shells of the enemy on the Serbian defences was so crushing that nothing could stand up against them. Entire companies were suffocated by the displacement of the atmosphere caused on the bursting of the 12-in. and 16½-in. shell.

Close contact with the Serbian forces was maintained by the pursuing cavalry; the distance separating the two hostile armies was at no time great.

The supply services of the Austro-German forces had to contend with considerable difficulties. For three weeks the whole of the supply wagons had to travel along the Belgrade-Mladenovac-Topola-Kragujevac road, at that time much broken up; the ruts were 18 in. to 2 ft. deep in some places; afterwards when the Austrian Engineers had effected the necessary repairs to the track the Belgrade-Nisch railway was also used by the pursuing troops for forwarding supplies.

Civilian transport was used almost entirely on the Austrian Lines of Communication, as all the army wagons were required with the troops in the fighting line.—(*To be concluded*).

BULLET AND BAYONET.

After calling attention to the article entitled "Some of the Precepts of the War" which appeared in the *Revue* for April and May, 1916 (*vide R.E. Journal* for July and August, 1916), the author of the *Revue* article states that he proposes to strike a somewhat different note to that sounded by Major Cerf, the author of "Some of the Precepts of the War."

Major Cerf found, it is said, in Major André's *Le Tir pour Vaincre* many ideas which appealed to him strongly as a musketry enthusiast. In consequence, in his own *Revue* article he has given a modern battle, it is suggested, too much the appearance of a Bisley Meeting or a pheasant *battue*. No saying is more true than the maxim: "Skill will beat mere brute strength," but the contents of Major Cerf's article do not correspond to the ideas which this maxim represents. After reading what Major Cerf says in his article those who share his convictions will, it is said, be tempted to exclaim: Skill at musketry will beat all things else.

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The writer of the *Revue* article is of opinion that it would be dangerous for the views contained in Major Cerf's article to be adopted, without reservation, in the Swiss Army and points out that since Major André wrote with the French Army in view, an army in which musketry training had been seriously neglected, it was permissible for him (André) to emphasize the value of rifle fire. But as in Switzerland rifle shooting had, at all times, received marked attention, Major André's arguments do not apply to the Swiss Army, where, unfortunately, too many already think that a good rifle-shot must necessarily be a *good soldier*.

The writer of the *Revue* article expresses the opinion that so long as nations go to war, the most important factor on the battlefield will be the man himself—*the man behind the gun*. If this man is lacking in courage and discipline, the most perfect rifle and the most modern appliances of war will not win victories, even where they are handled with skill.

Both what Major André has to say as well as Major Cerf's article prove that the soldier must know how to shoot, but, according to these two officers, it would almost appear that the soldier requires to know nothing else. The writer of the present *Revue* article considers that this view does not represent the true teaching of modern wars.

Major André, it is pointed out, wrote his work, *Le Tir pour Vaincre*, when the impressions caused by the battles of August, 1914, were still fresh in his mind, and at a time when the superiority of the fire of the German infantry had been an important factor in securing victory. At that time little experience of trench warfare had been gained.

The experiences of 1915 and 1916 certainly provided confirmatory evidence, if any was wanted, to show how important it is for soldiers to shoot well, but, at the same time, it also became very evident that rifle fire is far from being the only means of conducting an infantry fight. In the trenches, the infantryman to-day is using not only the bullet, but also the bayonet, the rifle grenade, the hand grenade, the revolver and the knife. And in addition, there are in use trench guns of various kinds, machine guns, asphyxiating gases, liquid fire, etc.; these are, as a rule, all being operated by specialists.

Musketry training is after all only one of the many branches of instruction which the infantry soldier must undergo; musketry is not, however, says the writer of the *Revue* article, proved to be the essential branch.

A Conference of British officers and N.C.O.'s was, it is said, held in October, 1915, when a lecture was given by an officer. Who this officer was, it is not known, but it is presumed he had recently returned from the Front. The lecturer did not by any means hold rifle fire in poor estimation, but he said little about it. In his view, the two principal factors making for the efficiency of infantry were physical development, and skill in handling the bayonet. There is a wide difference between these views and the teaching contained in the phrase, "Tir à vaincre."

Parts of the lecture referred to are quoted. The extracts given tell us that the lecturer pointed out that even centuries ago the ancient Greeks attached considerable importance to a man's physical qualities and, if anything, in the present war the need for physical strength has been shown to be greater than in past wars. In order that a man may

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be able to keep up a rapid and accurate rifle fire against any target his brain and muscles must be properly trained for the purpose. To execute a bayonet attack active and powerful men are required. Battles last long nowadays and troops are constantly exposed to all sorts of vagaries in the weather, etc. Heavy shells, mines, machine guns, grenades, night fighting destroy the nerves of all but seasoned soldiers.

In the present war, generals of the higher formations can exert little immediate influence on their commands. It is a fight of man against man, in which junior officers, N.C.O.'s and privates are playing the leading parts. And if a man does not possess a sufficiently robust frame and constitution, he soon breaks down and becomes unfit.

However, physical vigour is not everything, a soldier must also have an active brain and presence of mind; body and mind must act in co-operation.

Moreover, each man must have confidence in himself and in his subordinates. The three factors making for success are physical aptitude, co-operation between mind and body, and confidence.

The writer of the *Revue* article states that considerable progress has been made in the Swiss Army in respect of the matters just referred to, but as in every army raised on a Militia basis, the task of training it is similar to that imposed upon Sisyphus.

Passing to the bayonet, the writer of the *Revue* article says that both Major Cerf and Major André appear to hold this accessory to a rifle in poor estimation. Nevertheless Major Cerf admits that a bayonet is useful on occasions and recognizes that the training of an infantryman is not complete until he can use a bayonet skilfully. Continuing, he states that he is in hearty agreement with the British lecturer already referred to. The lecturer in question pointed out that there was no braver soldier than the German soldier, but he lacked initiative and aggressiveness. Excellent at long-range fighting, where discipline counts for much, the German soldier is at a hopeless disadvantage in a hand-to-hand fight; he cannot face the bayonet. The British soldier is the very opposite of the German soldier; the combative spirit is inborn in him; in long-range fighting, he, at times, fails to rise to the occasion, but when he sees red, he is the very devil himself. The lecturer holds the view that a warlike spirit without skill is of little value; further, that knowledge as well as willingness to fight is necessary. His views are briefly as follows:—It is necessary in war to kill not only at long range but also in hand-to-hand combat. To acquire skill with the bayonet, a longer and more continuous training is required than that necessary to handle a rifle expertly. If a man misses his target with a rifle on the battlefield, there is still a chance he may obtain a hit with his next shot; but when it comes to a bayonet fight the man who fails to deliver his first thrust dexterously he is almost sure to be a dead man before he can recover himself for his second thrust. Physical strength is necessary in thrusting with a bayonet to enable a man to drive it well into an adversary's body and to withdraw it again quickly. Rapidity in handling a bayonet is as important as rapidity in firing a rifle; it is essential not only that a man should be able to strike down his own opponent, but also that he should be able

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to render help to his comrades. Trenches must be "cleaned up" as quickly as possible in order that the counter-attack, which is sure always to follow, may be met with undivided attention; otherwise, the attack is likely to be a failure. The more a man feels that he has mastered the use of his bayonet the greater will be the confidence with which he will advance to the assault. A man should feel that he can take on three of the enemy single-handed.

The writer of the *Revue* article points out that others beside the British hold the bayonet in high esteem, and calls attention to the fact that Capt. Laffargue in his *Étude sur l'attaque dans la période* whilst expressing a preference for the bullet, by no means disparages the value of the bayonet.

To sum up, it is recommended that every infantryman should be able to use his rifle equally well for thrusting as for shooting. On the other hand, bombing and stabbing should be entrusted to specialists, who should be specially trained in the use of grenades and daggers in the same way that machine gunners and telephonists are trained in their own particular crafts.

A New Year's Reception, Generals and Policy.

In an introductory paragraph the editor of the *Revue* states that since the commencement of the War the archives of Pangermanism have been extensively searched in order that the causes of the War and its prime instigators might be definitely ascertained. It is pointed out that this research discloses that the propaganda in favour of a bigger Germany and the hegemony of the German Empire and of the Hohenzollerns was older and had been much more systematically pursued and was more widespread than people had thought to be the case during the period of peace preceding the outbreak of war, since, at that time, a soporific calm unfortunately prevailed to deceive the world. The fact that the whole of the German people, including the Socialists who, outwardly, were rabid anti-militarists, ranged themselves so unhesitatingly in support of the Great General Staff, proves conclusively that the present war was *their war*. Their attitude also provides evidence that the precipitation by Germany of the Great War caused the German people satisfaction and fulfilled all their expectations. The fact that such complete unanimity was shown in the matter by the German people and that the inhuman excesses of the Teutonic soldiery met with very general indulgence, not to say approbation, at the very outset, shows how deeply the canker of Pangermanism had contaminated the subjects of the Kaiser. It was the propaganda in question which was responsible for the ready acceptance of the theory that he who had Might on his side need pay no regard to Right.

An account, which appeared in the Munich *März* for February, 1909, is given later of an incident in the Pangerman Campaign. It deals with what passed at the reception of general officers held by the Kaiser on the 1st January, 1909. On that occasion Wilhelm II. called the attention of those attending the reception to an article on Military Policy which had appeared in the *Deutsche Revue*. The article in question

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related to the Pangerman Campaign and to the policy of aggression which was at that time being advocated in German military circles in opposition to the views held in the Chancellery of the Empire. This intervention of the Kaiser in a matter connected with military enterprises raised a storm in what up to that time had been Liberal Germany.

The following is a brief summary of the *März* article in question. This article states that it was shown, in a striking manner, on New Year's Day (*i.e.* 1909), how the Imperial Court treats certain questions, and how the ruling caste bring about confusion in matters which require unity in direction. What passed at the reception of the generals has become a matter of great perplexity to the German Press, which does not like unpleasant incidents to follow one another in close succession. Unquestionably the Kaiser, as Supreme Head of the Army, has an undeniable right to discuss military and policy matters with his generals. It is rather a question, how far these discussions are opportune and serve the interests of the Empire. Facts must, in this case, be allowed to speak for themselves.

The article proceeds: there has appeared, in the January number of the *Deutsche Revue*, an article entitled, "War at the Present Epoch." This article was contributed anonymously, but its contents betray that it has been written by someone having an inner knowledge of military matters. But the article has not attracted the attention it deserves, since the *Deutsche Revue* has not a wide circulation.

It is to this article that the German Emperor drew the attention of the generals attending the New Year's Day reception. On this occasion the whole article or extracts therefrom were read out by the Kaiser. Later, it came out that Count Schlieffen was the author of the article and that it had been submitted to the War Minister before publication. Since Count Schlieffen had, only a short time previously, been the Chief of the Great General Staff, it may be assumed that the article in question if not actually an official memorandum, nevertheless represented the views of the higher military authorities. It deals with questions of strategy and of policy; in the technico-military part, from one end to the other, the discussion of considerations affecting policy is closely mixed up with that relating to the purely military aspects of the subject.

The purely military part of the article makes interesting reading for lay folk. Unfortunately it is not possible to reproduce in the *R.E. Journal* all that Count Schlieffen has to tell us in his article, but the following are among the interesting matters touched upon by him. He points out that for 40 years conscription was a form of military service exclusively resorted to by Prussia, and no one envied her in this respect. However, since the experiences of 1866 and 1870, all the Powers have taken advantage of this method of raising armies, wherein lies the secret of the success which leads to victory. To make the most of this form of military service, it is necessary to reduce to the lowest possible limits the period of service with the colours. Germany, with a population of 62 millions, raises a contingent of 250,000 recruits annually, and a man remains liable for military service for a period of 19 years; whilst France, with a population of 40 millions, raises 220,000

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recruits annually and in that country a man remains liable for military service for a period of 25 years. On the outbreak of war (at the time Schlieffen wrote) the German Army would have numbered $4\frac{3}{4}$ million men and the French Army $5\frac{1}{2}$ million men.

In 1870, the German Army called up for service totalled $1\frac{1}{2}$ million men, of these only half a million took the field, and it may be assumed that of the present German Army (*i.e.* at the time of writing) not much more than about a million men would take the field. Such an army is no doubt very large compared with that which last took the field and would throw a heavy responsibility on the generalissimo who would have to command it and direct the operations; however, in view of the superiority of its armament, the mere increase in numbers as compared with the army of 1870, is insignificant, if the present-day army can be kept sufficiently in hand for operations with a single objective in view. To gain victory on a battlefield, it is the completeness of the bonds which tie the several parts of an army that matters most, and not so much contact with the enemy at any particular place. Even with the best field glasses no general can nowadays survey, from the most commanding feature of a battlefield, the whole extent of front on which his troops may be engaged. A general's place should, in consequence, be far in rear of the battle-front where, provided with the telephone and telegraph and other means of rapid communication at hand, such as motor cars he can remain in almost instantaneous touch with his subordinates and having a truer perspective of the battle, can direct their efforts so as to produce the most advantageous results.

The modern Alexander seated in a comfortable armchair with a map of the battlefield will receive reports, as his prototypes before him have done. These reports will differ from those of former ages not so much in their contents as in their number. The essential task of a modern generalissimo will, as a rule, have been completed some time before contact with the enemy is established; namely, at the time when he issues to the headquarters of his several armies, the routes and direction of their advance and approximately the objective assigned to each for the day's march.

Battles will, to be sure, last longer, but will not be more sanguinary than formerly. A strategy which contemplates a long-drawn-out wearing down of the enemy is no longer possible where the maintenance of an army of millions of men costing millions of pounds has to be provided for. In order to obtain a decisive success, an attack at two or three points against the front and one or both flanks of an enemy will be necessary. An attack of this kind is relatively easy to carry through provided sufficiently large bodies of troops are available. Cost what it may, troops must act on the offensive. It is with this object that long-range magazine rifles have been invented; the amount of execution one of these is capable of is equal to that done in the past by a considerable number of the older types of gun in action at the same time.

In order to attack the enemy's flank, it is necessary to know where it rests. Hitherto the task of ascertaining this has been one of the duties of the cavalry. In future, it is hoped that a flotilla of dirigibles

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will take over this duty and obtain the information required with greater certainty than cavalry have been capable of. In other respects there is likely to be very little change in the tactics of the several arms. In conclusion Count Schlieffen explains that H.E. projectiles, and even fortifications have been much improved and that the number of the fortified centres in France had been considerably increased; that to the north of France stood Belgium and Holland ready to come to her assistance; the former having barred the great road into Northern France by masses of concrete and armoured towers as well as by the impregnable fortress of Antwerp; that France had closed the passages across the Juras, and both France and Italy had provided defence works on the slopes of the Alps; that from the Zuyder Zee to the Mediterranean there had been built a Chinese wall; that Switzerland in barricading the St. Gothard Pass and the valleys of the Rhone and Rhine was also thereby assisting France; that Russia had put up fortifications directed against Germany and Denmark had seized control of the entrance into the Baltic Sea; that Great Britain, with the assistance of her "floating fortress," was assured of a port on the Jutland coast as a base from which to direct an attack on Schleswig; that the epidemic in fortress construction had reached such a point that Austria and Italy, although allies, had erected fortifications along their coterminous frontiers. The article in the *Deutsche Revue* ends with the statement: "The girdle of iron built up round Germany is provided with an opening only in the Balkans and this gap is about to be closed by Turkey, Serbia and Montenegro. In the centre, without any defence, stand Germany and Austria."

It is not the technical part of Count Schlieffen's article, in spite of its incursions into the domain of policy and the allegations concerning the hostile attitude towards Germany of neutral States, which at the time caused the serious misgivings, to which reference has already been made, but rather the conclusions which were to be drawn from the mischievous imputations concerning neutral countries contained in the statements made by the Count. Take for example, his introductory remarks in which he says: "The Peace of Frankfort between Germany and France is only a peace in appearance. Arms may have been grounded, but latently a war still subsists." Continuing the Count tells us that "France has never forgotten that in 1871 she swore to be revenged. And this idea of revenge, which is keeping all Europe standing to arms, has become the pivot round which every question of policy revolves." Again, "The powerful impetus which has been given to the industries and commerce of Germany have raised against her a second and irreconcilable enemy. British hatred is not likely to be diminished by any assurances of the sincere friendship and cordial sympathy which Germany is ready to give her." Turning to Germany's eastern neighbour, the Count states: "Russia continues to be fast bound to her old ally, owing to the hereditary antipathy of the Slavs against the Germans, her traditional sympathy for the Latin races and in consequence of her need for financial assistance; she is in the act of throwing herself into the arms of that Power of all others which can strike in the way to bring about the most direful results to her." Of

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Germany's one-time ally, he remarks: "Italy considers that the expulsion of the stranger from beyond the Alps is not yet complete."

Had the Count's article been written by a non-official member of the German Navy League or some other black-coated member of the German community, there might have been little significance in it. But being written, as it was, by an ex-Chief of the Great General Staff the article at once acquired importance as soon as its true authorship was revealed. "It would have been in the best interests of Germany," says the writer of the *März* article, "if the author of the *Deutsche Revue* article had remained anonymous. But Wilhelm II. appears to have thought otherwise, and by his action caused greater importance to be attached to the views of an officer of high rank, whose name was then still unknown, than to the views of the highest authority in the State.

An attempt was made by the *Reichsanzeiger*, six days after the New Year's Day reception, to explain away what had occurred at the meeting of the Kaiser and his generals; it was said that purely military matters, to the exclusion of questions of policy, were discussed at the reception. These explanations, it is said, were not accepted in the Chancelleries of the European capitals, but were only looked upon as an official confirmation of the view that the German Emperor was in agreement with the views of the anonymous author of the article in the *Deutsche Revue*.

The *März* article concludes with the following remarks: "In order to bring about an improvement in the situation it is necessary that Field Marshal Lord Roberts and Count Schlieffen should learn to exercise more reserve, but it is further incumbent on the Kaiser to bear in mind that each one of his acts may become public property, and he should understand that only those of them are useful to Germany which can be made public at the time of their occurrence."

Notes and News.

Switzerland.—The turn of the Romand troops to come on frontier duty has come round for the third time. This fact has given considerable satisfaction in some quarters in Switzerland.

The newly organized machine-gun companies of the Swiss Army are proving a great success. Marked improvement in the self-confidence shown by the junior officers with these units has been noticed.

A brief reference is made to the left wing of the Allies' position between Nieuport and Dixmude. It is said that the Allied line along this part of the front lies on the enemy's side of the inundations in this region. Long foot bridges have been provided across the inundations to enable reliefs, etc., to be carried out. Communication services have received considerable attention on this part of the front. The telephone, the telegraph, wireless, lamps, heliographs and even the pigeon post are all playing a useful part there.

An incident in connection with an article entitled *Gang nach Canossa* which appeared in the *Gazette de Soleure* for 23rd August last has caused some little perturbation in Switzerland. Colonel Loys, commanding the 2nd Swiss Division, wrote a note to the author of the article and addressed it to the Editor of the *Gazette*, apparently not intending his remarks to

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be published. The Colonel had approved of the sentiments in the article in question in somewhat unfortunate terms in view of the general situation in Switzerland. Owing to the public feeling aroused, the Federal Council had to take notice of the incident; in consequence, a severe reprimand has been administered to Colonel Loys. The disciplinary action taken in this case is thought by some to be too weak.

Portugal.—A special correspondent expresses the view that Germany has not looked with favour to the progress made by the Portuguese in recent times. The Germans, he tells us, have long coveted the Portuguese possession of Angola, and in the early days of the War provoked a quarrel by attacking the Portuguese troops in that colony. However, outwardly the two nations appeared to continue to live in peace. This did not satisfy Germany; she seems to have made up her mind to drag Portugal into the maelstrom. The requisitioning of the German ships in Portuguese territorial waters afforded the pretext for a rupture, although a similar act on the part of Italy, earlier in the War, was entirely disregarded by her. At one time, the Portuguese were desirous of keeping out of the War, but there has been, it is said, a complete veering round in public opinion on this subject. Military preparations which will allow Portugal to play an active part in the War are being pushed on with great vigour.

This number of the *Revue* concludes with a bibliography in which the names of many works dealing with the present war appear.

W. A. J. O'MEARA.

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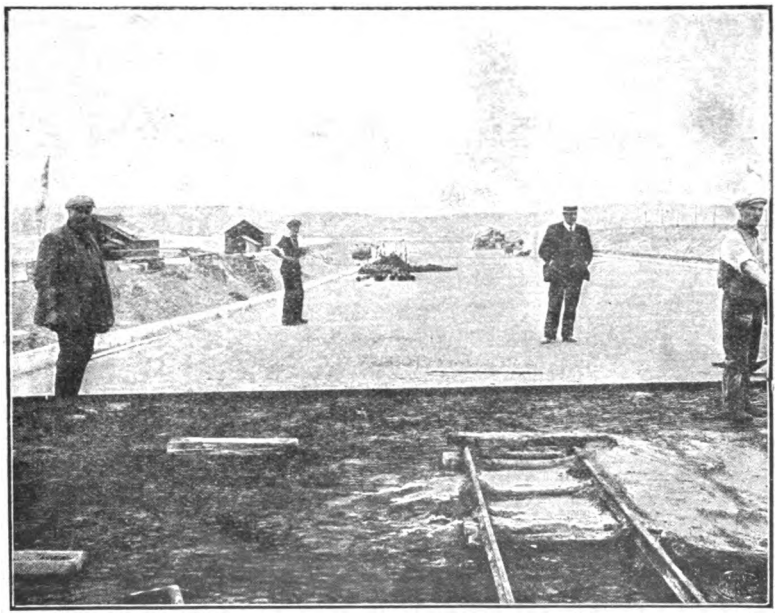

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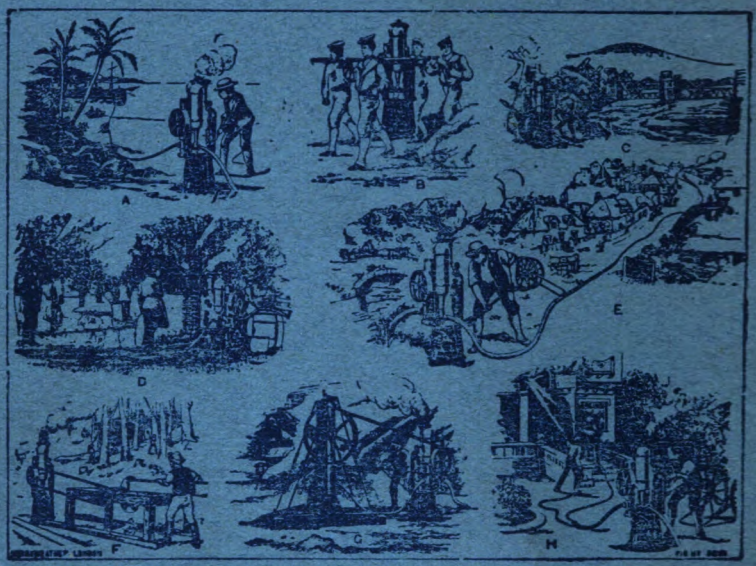

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